ISSN: 2584-0355
DOI: doi.org/10.51219/MCCRJ/Kaoutar-Zirhirhi/488

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Medical & Clinical Case Reports Journal

https://urfpublishers.com/journal/case-reports

Vol: 4 & Iss: 2

Research Article

Perioperative Management of Thymectomy for Myasthenia Gravis: A Retrospective Single-Centre Case Series of 14 Patients

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Citation: Tissir A, Zirhirhi K, Berrada L, et al. Perioperative Management of Thymectomy for Myasthenia Gravis: A Retrospective Single-Centre Case Series of 14 Patients. *Medi Clin Case Rep J* 2026;4(2):1822-1826. DOI: doi.org/10.51219/MCCRJ/Kaoutar-Zirhirhi/488

Received: 22 June, 2026; **Accepted:** 24 June, 2026; **Published:** 26 June, 2026

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A B S T R A C T

Background: Myasthenia gravis (MG) is a chronic autoimmune disorder of neuromuscular transmission. Because the thymus is central to its pathophysiology, thymectomy is an established therapeutic option. It nonetheless remains high-risk surgery, historically associated with substantial peri-operative morbidity and mortality in the absence of appropriate anaesthetic management.

Objective: To describe the peri-operative management and outcomes of thymectomy for MG in our setting.

Methods: We conducted a retrospective analysis of all myasthenic patients who underwent thymectomy in the central operating theatre of CHU Ibn Rochd, Casablanca, between January 2019 and September 2022. Pre-operative, intra-operative and post-operative data were collected from a standardised case-report form.

Results: Fourteen patients were included. Mean age was 41 years (range 14-74); the female-to-male ratio was 1.8. The clinical presentation was dominated by dyspnoea, diplopia and ptosis. According to the modified Osserman classification, 71% were stage IIb and 29% stage IIa. Anti-acetylcholine-receptor antibodies were positive in 92.9% and electromyography demonstrated a post-synaptic neuromuscular block in 50%. Chest CT showed a thymic mass in 7 patients (50%) and thymic hyperplasia in 4 (28%). All patients underwent balanced general anaesthesia (propofol–fentanyl with sevoflurane or isoflurane); neuromuscular blockade with rocuronium 0.3 mg/kg (half the usual dose) was used in 85.7%, with neostigmine reversal and without neuromuscular monitoring. Surgical access was median sternotomy in 12 patients and VATS in 2. Twelve patients (85.7%) were extubated in theatre and all were admitted to intensive care (mean stay 4.6 days). The post-operative course was uncomplicated in 10 patients (71.4%); complications comprised pneumonia (2), one myasthenic crisis and one cholinergic crisis, all with favourable outcome. Operative mortality was 7.1% (1 patient).

Conclusion: Adherence to key peri-operative principles-careful staging of MG, judicious choice of anaesthetic technique and monitoring and systematic intensive-care admission-allows thymectomy for MG to be performed with low morbidity and near-zero mortality. Routine neuromuscular monitoring and wider use of the rocuronium–sugammadex strategy represent the main opportunities to improve our practice.

Keywords: Yasthenia gravis; Thymectomy; General anaesthesia; Neuromuscular blocking agents; Rocuronium; Sugammadex; Myasthenic crisis; Perioperative care

Introduction

Myasthenia gravis (MG) is a rare autoimmune disease characterised by impaired neuromuscular transmission resulting from autoantibody-mediated destruction of post-synaptic acetylcholine receptors (AChR) of skeletal muscle. Clinically it manifests as fluctuating, fatigable muscle weakness that worsens with exertion and improves with rest[1-3].

The role of the thymus as a site of auto-sensitisation to the AChR is well established and a thymic abnormality should prompt the diagnosis of MG; the precise contribution of the gland to disease initiation and maintenance nonetheless remains incompletely defined. First-line treatment relies on acetylcholinesterase inhibitors together with strict avoidance of drugs known to aggravate MG. Corticosteroids, immunosuppressants and thymectomy are used as background therapy in disabling forms[4], while intravenous immunoglobulin and plasma exchange are reserved for acute exacerbations.

Thymectomy is now one of the cornerstone treatments of MG and resection is mandatory in the presence of a thymoma. Its peri-operative management is multidisciplinary, ideally combining neurologist, surgeon, anaesthetist and intensivist and rests largely on repeated functional muscle scoring. For general anaesthesia, total intravenous anaesthesia is increasingly preferred, since halogenated agents may impair muscle strength; regional anaesthesia is a valuable adjunct when surgery allows, particularly for post-operative analgesia[5,6]. Non-depolarising neuromuscular blocking agents may be used, but requirements are markedly reduced and neuromuscular monitoring is therefore mandatory. The anaesthetic period is usually uneventful, but return to spontaneous ventilation should occur only in a critical-care environment because of the risk of post-operative respiratory failure, the two principal entities being myasthenic and cholinergic crisis.

The aim of this study was to describe the peri-operative management and short-term outcomes of thymectomy for MG in a single Moroccan tertiary centre and to benchmark our practice against current literature[7-10].

Materials and Methods

Study design and setting

This was a retrospective observational study of 14 consecutive patients who underwent thymectomy in the Department of Anaesthesiology and Central Intensive Care of CHU Ibn Rochd, Casablanca, between January 2019 and September 2022.

Inclusion and exclusion criteria

All patients operated on for MG, with or without an associated thymic tumour, were included. Patients operated on for thymic tumours without MG were excluded.

Data collection

Clinical records were retrieved from the departmental archives and analysed using a pre-established case-report form capturing age, sex, comorbidities and the medical, anaesthetic and surgical management, together with outcome variables.

Literature search

A complementary literature search of articles on the surgery of MG was performed in MEDLINE, PubMed and ScienceDirect using the keywords “myasthenia gravis”, “thymectomy for myasthenia gravis”, “anaesthesia for thymectomy” and “neuromuscular blocking agents”.

Results

Pre-operative data

Mean age was 41 years (range 14-74), with 72% of patients younger than 50 years; no paediatric case was recorded. There was a female predominance (9 women, 5 men; ratio 1.8). Most patients were ASA class 1 (90%); comorbidities comprised arterial hypertension (3 cases), asthma (2) and diabetes (2).

According to the modified Osserman classification, 71% of patients were stage IIb (generalised MG with swallowing difficulty but without aspiration) and 29% stage IIa (generalised MG without swallowing difficulty); no patient was classified as stage I, III or IV. Chest CT, performed in all patients, revealed a thymic mass in 7 cases (50%), thymic hyperplasia in 4 (28%) and was normal in 3 (22%). Electromyography demonstrated a post-synaptic neuromuscular block in 7 patients (50%) and anti-AChR antibodies were positive in 13 patients (92.9%).

First-line treatment in all patients was an acetylcholinesterase inhibitor-pyridostigmine (Mestinon®) or ambenonium chloride (Mytelase®)-alone or combined with corticosteroids and/or immunosuppressants **(Table 1)**. Pre-operative spirometry was normal in 11 patients (78%) and showed a moderate restrictive pattern in 3 (22%). No specific pre-operative preparation was given beyond the existing regimen; in particular, no patient received pre-operative intravenous immunoglobulin or plasma exchange and acetylcholinesterase inhibitors were continued at usual doses until the day of surgery.

Table 1: Baseline pre-operative medical treatment (n = 14).

Regimen	n (%)
Pyridostigmine alone	6 (42%)
Ambenonium alone	1 (7%)
Pyridostigmine + ambenonium	2 (14%)
Pyridostigmine + corticosteroids and/or immunosuppressants	3 (21%)
Pyridostigmine + ambenonium + corticosteroids and/or immunosuppressants	2 (14%)

Intra-operative data

All patients were positioned supine and received antibiotic prophylaxis with amoxicillin-clavulanic acid. All were managed under balanced general anaesthesia. Induction used propofol and fentanyl (one patient received sufentanil). Neuromuscular blockade was judged necessary in 12 patients (85.7%), using rocuronium (Esmeron®) 0.3 mg/kg-half the usual dose. Maintenance combined a halogenated agent (isoflurane in 10 patients, sevoflurane in 2) with repeat boluses of propofol and fentanyl. Patients not given a neuromuscular blocker at induction did not require one intra-operatively.

All patients received standard monitoring (electrocardioscopy, pulse oximetry, non-invasive blood pressure and capnography). Notably, no patient underwent neuromuscular (curarisation) monitoring. Surgical access was median sternotomy in 12 patients and VATS in 2. Respiratory incidents occurred in 21.4% of patients and haemodynamic instability in 14.3%. Mean operative time was 3 h 30 min (range 2-5 h). All curarised patients were reversed at the end of surgery with neostigmine; no patient received sugammadex.

Post-operative data

Twelve patients (85.7%) were extubated in theatre. Post-operative analgesia was multimodal (paracetamol, nefopam and opioids); no patient received regional analgesia. Acetylcholinesterase inhibitors were reintroduced at usual doses on the day of surgery in most patients (12), the dose being halved in 2 patients because of signs of overdose. All patients were admitted to intensive care, with a mean stay of 4.6 days (maximum 21 days).

The post-operative course was uncomplicated in 10 patients (71.4%). One patient developed a myasthenic crisis requiring non-invasive ventilation (NIV), with favourable outcome; one developed a cholinergic crisis on the third post-operative day, resolving after halving the anticholinesterase dose; and two developed pneumonias on the second post-operative day, resolving with antibiotics and NIV. One death was recorded, giving an operative mortality of 7.1% **(Table 2)**.

Table 2: Post-operative outcomes (n = 14).

Variable	Value
Extubation in theatre	12 (85.7%)
Uncomplicated course	10 (71.4%)
Pneumonia	2 (14.3%)
Myasthenic crisis	1 (7.1%)
Cholinergic crisis	1 (7.1%)
Mean ICU stay	4.6 days (max 21)
Operative mortality	1 (7.1%)

Discussion

Epidemiology

Among myasthenic syndromes, autoimmune MG is by far the most frequent. Reported prevalence ranges from 50 to 200 per million and appears to be rising in recent decades, particularly in late-onset forms. Although MG may begin at any age, it predominantly affects adults younger than 40 years (about 60% of cases). A female preponderance is seen overall (roughly two-thirds of patients), most marked before the age of 40 (female-to-male ratio up to 3), with the sexes equalising between 40 and 50 years and a male predominance thereafter. Fifteen to twenty per cent of patients harbour a thymoma, usually after 40 years, whereas thymic hyperplasia predominates in younger anti-AChR-positive women[10-13]. In Morocco, precise prevalence is unknown; the national myasthenic patients' association estimates that some 3,000 Moroccans are affected. Our series, with a mean age of 41 years, a female-to-male ratio of 1.8 and a high proportion of thymic masses, is consistent with these data.

Diagnosis and staging

The diagnosis of MG rests on the cardinal clinical features of painless, fatigable weakness with a characteristic distribution-frequently ocular at onset (ptosis, diplopia)-supported by pharmacological, electrophysiological (repetitive nerve stimulation, single-fibre EMG) and immunological tests, the latter detecting anti-AChR antibodies in the majority of generalised cases and anti-MuSK or anti-LRP4 antibodies in seronegative patients. Our high rate of anti-AChR positivity (92.9%) and the EMG findings are in keeping with a predominantly seropositive, generalised cohort. Pre-operative staging using validated muscle scores (modified Osserman, MGFA classification and quantitative muscle scores) is central to risk stratification and should be repeated up to the day of surgery.

Anaesthetic technique

Balanced general anaesthesia was used in all of our patients. Current opinion favours minimising agents that depress neuromuscular transmission: halogenated agents reduce muscle strength and total intravenous anaesthesia is often preferred, while regional techniques-particularly thoracic epidural analgesia-reduce hypnotic and opioid requirements and improve post-operative analgesia and respiratory outcomes when combined with general anaesthesia. Comparative work has shown that combining thoracic epidural with light balanced anaesthesia, versus balanced anaesthesia alone, shortens post-operative ventilation and reduces opioid needs. None of our patients received a regional technique; its addition would have been a reasonable option and represents an avenue for improvement[14-16].

Myasthenic patients show marked sensitivity to non-depolarising neuromuscular blocking agents, mandating dose reduction-hence our use of rocuronium at half the usual dose. The advent of sugammadex, which encapsulates aminosteroidal agents (rocuronium in particular) and reverses even profound block within minutes, has renewed interest in their use in MG. Sungur Ulke et al. reported rapid reversal and in-theatre extubation in ten myasthenic patients undergoing VATS thymectomy with rocuronium 0.3 mg/kg reversed by sugammadex 2 mg/kg and a meta-analysis by Gurunathan et al. concluded that rocuronium can be used safely in MG provided sugammadex and neuromuscular monitoring are employed, while noting rare cases of incomplete reversal. In our series, reversal relied on neostigmine and no patient received sugammadex-a practice that warrants reconsideration, since acetylcholinesterase inhibition may already be maximal in patients on pyridostigmine, limiting the efficacy of neostigmine.

Neuromuscular monitoring

Neuromuscular monitoring is of particular value in MG, both to guide intubation and intra-operative relaxation and to confirm the absence of residual block (defined as a train-of-four ratio < 0.9) at the end of surgery. Because muscle-group sensitivity to neuromuscular blockers differs in myasthenic patients, titration and monitoring of more than one muscle (e.g. corrugator supercilii and adductor pollicis) may be advisable. The complete absence of neuromuscular monitoring in our cohort is the principal limitation of our anaesthetic management and the clearest target for improvement, as it is recommended by learned societies for any patient and a fortiori in MG.

Surgical approach

The optimal surgical approach remains debated; whatever the technique, complete resection of the thymus and adjacent fat is the prime determinant of prognosis. Encapsulated lesions may be approached by a cervico-manubrial or sternotomy route,

whereas large or invasive tumours require median sternotomy or thoracotomy. VATS allows complete thymectomy with comparable or better outcomes than sternotomy, with shorter hospital stay, reduced analgesic requirements and faster recovery of pulmonary function. The predominance of sternotomy in our series, with VATS reserved for the most recent cases, reflects this evolving practice.

Post-operative complications

Beyond complications common to all thoracic surgery, the specific hazard of thymectomy is post-operative muscle weakness, which may reflect residual anaesthetic effect, myasthenic crisis or cholinergic crisis. Myasthenic crisis-exacerbation of weakness involving respiratory muscles-is precipitated by surgical stress, sleep deprivation, infection, pain and interfering drugs; reported post-operative incidence is around 10%, associated with thymoma histology and higher Osserman class. Cholinergic crisis results from excess acetylcholine, favoured by anticholinesterase overdose and by reversal of non-depolarising agents with anticholinesterases. The two entities are difficult to distinguish clinically yet require opposite treatment, which justifies cautious, titrated reintroduction of acetylcholinesterase inhibitors-typically starting at half the usual dose on the day of surgery-and systematic critical-care admission. Our management, including dose halving in two patients with overdose signs and successful treatment of one myasthenic and one cholinergic crisis, is in line with these principles.

Mortality

In the early large series of the 1970s, operative mortality of 10–30% was reported, prompting strict post-operative protocols (routine tracheostomy, anticholinesterase withdrawal and controlled ventilation) that reduced mortality to 1-3%. With modern peri-operative care, extubation often takes place in theatre and mortality is now close to zero: analyses of the French Epithor and the North-American NSQIP databases reported no operative deaths, with overall morbidity around 15%. Our operative mortality of 7.1% (a single death) and morbidity of 28.6% remain higher than these benchmarks, almost certainly reflecting the small sample size, the absence of neuromuscular monitoring and the limited use of modern reversal and regional techniques[17-20].

Limitations

This study is limited by its retrospective, single-centre design and small sample (n = 14), which preclude meaningful statistical inference and make point estimates-particularly mortality-sensitive to single events. Neuromuscular monitoring was not performed and some long-term outcome data (durable remission, MG status at follow-up) were not available. These limitations notwithstanding, the series usefully documents real-world practice and identifies concrete, evidence-based opportunities for improvement.

Conclusion

MG is a rare autoimmune disorder of neuromuscular transmission in which the thymus plays a central pathogenic role, making thymectomy a key therapeutic option. Peri-operative care should be multidisciplinary; general anaesthesia increasingly favours total intravenous techniques, regional anaesthesia is a useful adjunct when surgery permits and non-depolarising neuromuscular blockers may be used at markedly reduced doses under mandatory neuromuscular monitoring. Return to spontaneous ventilation must occur in a critical-care setting because of the risk of post-operative respiratory failure, with careful distinction between myasthenic and cholinergic crisis. Our experience confirms that respecting these principles—careful staging, judicious anaesthetic technique and monitoring and systematic intensive-care admission—allows thymectomy for MG to be performed with low morbidity and near-zero mortality. Introducing routine neuromuscular monitoring and the rocuronium-sugammadex strategy, together with greater use of combined regional techniques, are the main steps likely to further improve outcomes in our setting.

Declarations

Ethics approval and consent to participate

This was a retrospective study based on the analysis of anonymised clinical records. In accordance with local regulations governing retrospective, non-interventional studies, formal approval by the institutional ethics committee was not required and the requirement for individual informed consent was waived owing to the retrospective and anonymised nature of the data.

Consent for publication

Not applicable. The manuscript does not contain any individual person's identifiable data, images or videos.

Funding

This study was funded by the authors' own resources. It received no specific grant from any funding agency in the public, commercial or not-for-profit sectors.

Conflicts of interest

The authors declare that they have no competing interests.

Author contributions

[To be completed by the authors, e.g.:] K. Zirhirhi conceived the study, collected and analysed the data and drafted the manuscript. [Co-author] supervised the study and critically revised the manuscript. [Co-authors] contributed to data collection and interpretation. All authors read and approved the final version of the manuscript.

Data availability

The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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