Myasthenia Gravis Handbook

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I. Understanding Myasthenia Gravis

Myasthenia Gravis (MG). According to epidemiological estimates, approximately 20–25 people per 100,000 population in Taiwan are affected by this disease. According to National Health Insurance statistics, as of January 2026, there were 6,484 patients with myasthenia gravis holding a certificate of severe illness.

Myasthenia gravis is an autoimmune disease that causes varying degrees of muscle weakness. Commonly affected areas include the muscles controlling eye movements, the muscles involved in chewing and swallowing, the muscles used for speech, and the muscles of the limbs. Because the affected muscle groups and severity vary from patient to patient, clinical presentations may also differ.

The age of onset for myasthenia gravis follows a bimodal distribution: it is more common in women aged 20 to 30, while men over 50 are more frequently affected. The overall male-to-female ratio is approximately 1:1.8. In recent years, there has been an increasing trend in new diagnoses among the elderly population.

II. Pathogenic Mechanisms

Muscle contraction depends on the release of a chemical substance called acetylcholine from motor nerve endings. When acetylcholine binds to receptors on the muscle surface, it triggers a change in electrical potential, causing the muscle to contract. Once signal transmission is complete, acetylcholine is broken down by acetylcholinesterase, allowing the neuromuscular junction to return to its resting state.

Myasthenia gravis is an autoimmune disease. In patients with this condition, the immune system produces abnormal antibodies that target components of the neuromuscular junction, causing damage to or a reduction in the number of receptors or related proteins, which disrupts signal transmission between nerves and muscles.

In addition to the presence of autoantibodies detectable in the blood, some patients may also have thymic hyperplasia or thymoma. Based on age at onset, cases occurring before the age of 16 are classified as juvenile myasthenia gravis, while those occurring at or after age 16 are classified as adult myasthenia gravis.

III. Symptoms and Characteristics

I. Characteristics of Myasthenia Gravis

A typical feature of myasthenia gravis is that symptoms "worsen with activity and improve with rest." Muscles tend to become weak after repeated use, but strength usually partially recovers after rest or sleep. Therefore, patients often feel stronger and move more smoothly upon waking in the morning; however, as daily activity increases, symptoms of weakness may gradually worsen by the afternoon or evening.

II. Symptoms of Myasthenia Gravis

- The most common manifestations of myasthenia gravis are ocular symptoms; approximately 90% of patients experience drooping eyelids, blurred vision, or double vision.
- Depending on the muscle groups affected, patients may also experience weakness in chewing and difficulty swallowing, making them prone to choking while eating.
- Some patients experience neck weakness, making it difficult to hold their head up for long periods. Speech may be affected by slurred speech, mumbling, or hoarseness; these symptoms often become more pronounced the longer the patient speaks.
- If respiratory muscles are affected, patients may have difficulty coughing up phlegm or experience shortness of breath.
- In daily life, activities such as combing hair, brushing teeth, climbing stairs, or walking may still be possible in the early stages, but significant weakness is likely to be felt after repeated performance. This phenomenon of worsening with use is one of the key characteristics of myasthenia gravis.

III. Juvenile Myasthenia Gravis

◎ The annual incidence of juvenile myasthenia gravis varies by region. In Europe, it is approximately 1–2 cases per million people, while in Eastern countries, it is about 7 cases per million.

◎ Compared to the adult-onset form, ocular muscle weakness is a common manifestation of the juvenile form, and it has a relatively higher probability of spontaneous remission.

◎ In pre-adolescent patients, symptoms are typically milder, and autoantibodies may be negative; however, they may still turn positive as the patient ages. For antibody-negative patients, regular follow-up at least every six months is recommended.

◎ It is important to emphasize that children are not simply smaller versions of adults. Because their bodies are still developing, symptom presentation, disease progression, and drug metabolism may differ from those in adults. Assessment and management should be conducted by a specialist with experience in pediatric neuromuscular diseases.

IV. Diagnostic Tests

I. Ice Pack Test

During outpatient evaluation, a simple cold pack test can be used as an adjunctive diagnostic tool. After applying an ice pack to the drooping eyelid for approximately two minutes, a temporary improvement in ptosis may be observed in some patients. This phenomenon is related to the inhibition of acetylcholine breakdown by cold temperatures, which can temporarily enhance neuromuscular transmission and has certain diagnostic value for ocular myasthenia gravis.

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II. Blood tests for antibodies

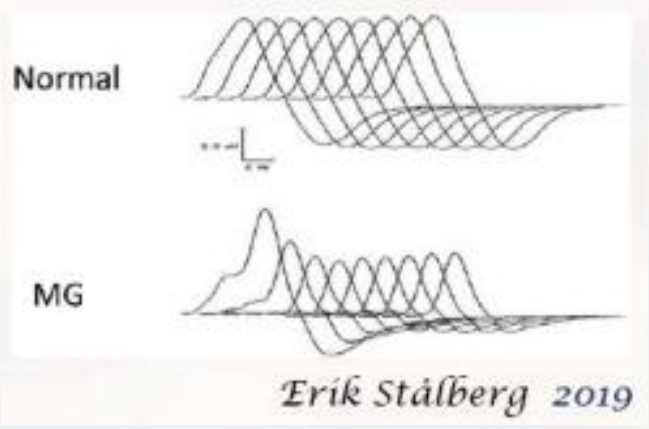
Blood tests are one of the key methods for diagnosing myasthenia gravis. These tests can assess the presence of relevant autoantibodies. In the general healthy population, antibody titers are typically very low, whereas patients with myasthenia gravis may exhibit higher titers. In some patients, there is a certain correlation between antibody titers and clinical severity.

◎ Myasthenia gravis can be classified based on the types of autoantibodies present in the serum:

- Acetylcholine receptor antibody-positive type, which accounts for the highest clinical proportion.
- If acetylcholine receptor antibodies are negative, further testing for other relevant antibodies may be performed, including:
  - MuSK (muscle-specific kinase) antibodies
  - LRP4 (low-density lipoprotein receptor-related protein 4)
  - If both of the above antibodies are negative, the condition may be due to other, rarer antibody types.
- Regarding the current testing situation in Taiwan, acetylcholine receptor antibody testing is available at most major hospitals.
- MuSK antibody testing is provided by some medical centers or hospitals with specialized testing facilities.

III. Repetitive Nerve Stimulation Test

During the test, motor nerves are stimulated at a frequency of approximately three times per second, and changes in the amplitude of the muscle action potential are recorded. Under normal conditions, the amplitude of the muscle action potential should remain stable without significant decline. However, if there is a conduction abnormality at the neuromuscular junction, the muscle action potential may gradually decrease as the number of stimulations increases; this phenomenon can serve as a diagnostic reference.



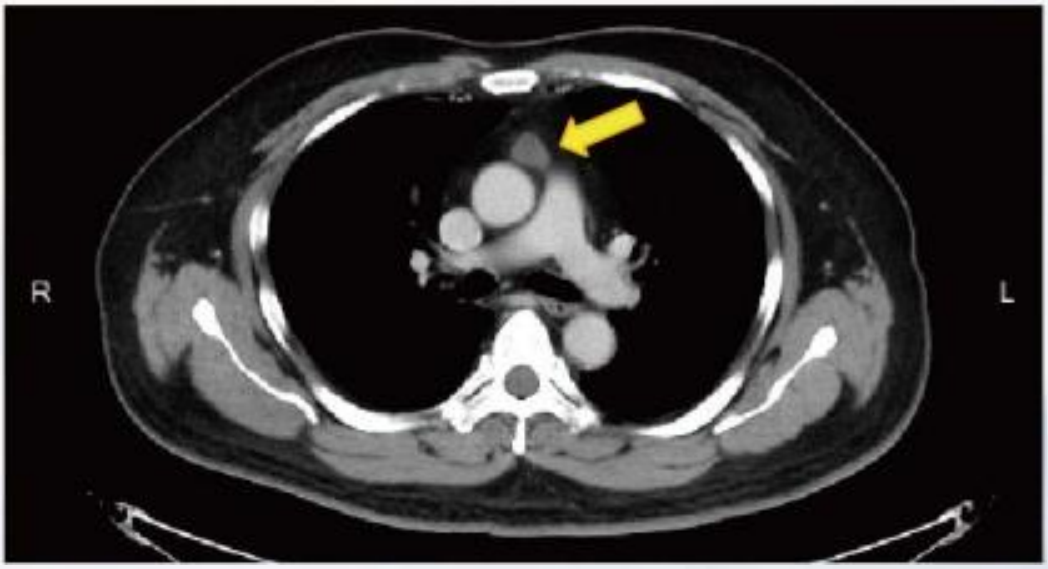
IV. Single-Fiber Electromyography

Used to record the action potentials of individual muscle fibers, this is a highly sensitive test for assessing the stability of neuromuscular transmission. When neuromuscular transmission is abnormal, the time difference between action potentials may increase. In the electrophysiological evaluation of myasthenia gravis, single-fiber electromyography has a high detection rate; however, a comprehensive assessment must still be made by combining clinical symptoms with the results of other tests.

V. Chest Computed Tomography

◎ Some patients with myasthenia gravis may have associated thymic abnormalities, including thymic hyperplasia or thymoma. Studies indicate that thymic hyperplasia is not uncommon in these patients, and approximately 10–20% may have thymoma. Therefore, following a diagnosis of myasthenia gravis, a chest CT scan is typically scheduled to evaluate the thymus and determine the presence of any tumors.

◎ Confirming the presence of thymic abnormalities is crucial for subsequent treatment planning. Decisions regarding the need for further surgical evaluation or other therapeutic measures must be made based on a comprehensive assessment of the examination results and clinical presentation.



V. Staging

Classified into five types based on symptom severity (MGFA classification)	
I	Ocular muscle weakness only (limited to the extraocular muscles)
IIa	Mild generalized weakness (primarily affecting limb muscles)
IIb	Mild generalized weakness (primarily affecting muscles involved in swallowing or breathing)
IIIa	Moderate generalized weakness (primarily affecting limb muscle groups)
IIIb	Moderate generalized weakness (primarily involving muscles related to swallowing or breathing)
IVa	Severe generalized weakness (primarily affecting limb muscle groups)
IVb	Severe generalized weakness (primarily affecting swallowing or respiratory muscles)
V	Respiratory failure (requiring intubation or mechanical ventilation support)

VI. Treatment Options

I. Acetylcholinesterase Inhibitors

Pyridostigmine (brand name Mestinon, commonly known as "Power Pills") is one of the most commonly used symptomatic control medications for myasthenia gravis. Its mechanism of action involves inhibiting acetylcholinesterase, thereby increasing acetylcholine concentrations at the neuromuscular junction and improving muscle contraction. The effects generally begin approximately 20–40 minutes after administration, and a gradual increase in muscle strength can be felt. The effects typically last for about 3–4 hours before gradually wearing off; therefore, regular, divided doses are usually required to maintain stable symptom control.

Side Effects

Abdominal cramps, nausea, diarrhea, increased sweating, increased salivation, localized muscle twitching, slowed heart rate, and increased urination. Most side effects are related to increased acetylcholine activity; clinically, the dosage can be adjusted based on symptoms, or symptomatic treatment medications can be administered.

◎ Medication Precautions

◎ Follow your doctor’s prescription and take the medication on time to maintain stable muscle strength. Before starting the medication, discuss it with your doctor and adjust the timing to fit your daily routine.

◎ It is recommended to schedule physically demanding activities 1 to 2 hours after taking the medication, as the drug’s effects typically peak during this time. Additionally, taking the medication immediately after a meal can help reduce stomach discomfort. If you have difficulty chewing or swallowing, it is recommended to take the medication 30 minutes before a meal to facilitate eating.

◎ If you experience shortness of breath or difficulty swallowing 20–40 minutes after taking “Power Pills,” this may indicate an overdose; seek medical attention immediately. Additionally, avoid taking multiple doses of power pills within a short period; an interval of 3–4 hours is recommended to minimize potential side effects.

II. Immunosuppressive Therapy

1. Corticosteroids (Prednisone)

Corticosteroids are one of the most commonly used immunomodulatory drugs. Steroids have anti-inflammatory effects and suppress immune responses. In myasthenia gravis, autoantibodies produced by the immune system attack the neuromuscular junction; therefore, moderate suppression of the immune response helps reduce antibody activity and improve muscle strength.

Although corticosteroids can effectively control disease activity, their immunosuppressive effects may increase the risk of infection and lead to side effects such as elevated blood sugar, weight gain, bone loss, and mood changes. Therefore, during treatment, a physician must evaluate the dosage and conduct regular follow-ups.

When using steroids or other immunosuppressive medications, patients should take them regularly as prescribed by their physician and must not adjust the dosage or stop taking the medication suddenly on their own. If any unusual symptoms occur, patients should return to the clinic promptly for evaluation.

◎ Side Effects

The side effects of steroids are related to the dosage, frequency of use, duration of treatment, and individual medical conditions. Generally, the longer the duration of use and the higher the dosage, the greater the likelihood of side effects. Common side effects include:

① Increased stomach acid secretion, gastritis, or gastric ulcers.
② Elevated blood sugar or worsened diabetes control.
③ Weakened immune system, increasing the risk of infection.
④ Elevated blood pressure.
⑤ Bone loss or osteoporosis.
⑥ Weight gain, a rounder face (commonly known as a “moon face”), and acne.
⑦ Mood swings, anxiety, or insomnia.

It is important to note that the side effects listed above are general descriptions; actual experiences vary from person to person. During treatment, you should attend regular follow-up appointments so your doctor can assess the risks and benefits.

If you experience any suspected side effects or feel unwell, you should discuss this with your healthcare team as soon as possible so that your treatment plan can be adjusted promptly.

◎ Other Precautions Related to Steroids

- When taking steroids, it is recommended to take them after meals to reduce stomach discomfort. At the same time, avoid excessive intake of high-sodium foods, such as canned or pickled foods, to lower the risk of fluid retention and increased blood pressure.
- Long-term use of steroids may increase the risk of bone loss. It is recommended to supplement with appropriate amounts of calcium and vitamin D, and to consult your doctor to determine if a bone density test is necessary.
- Some patients may experience electrolyte imbalances, such as fluid retention or low potassium levels. If a doctor confirms hypokalemia, dietary adjustments can be made under professional guidance. Potassium-rich foods include bananas, oranges, guavas, persimmons, and dark green vegetables. If you have kidney disease or are taking medications that affect potassium levels, you should discuss this with your doctor first. Although low-sodium salt contains higher levels of potassium, it is not suitable for all patients.
- Do not suddenly stop taking steroids on your own. If you need to reduce the dosage or stop taking them, adjustments should be made gradually under a doctor's supervision to avoid adrenal suppression or a relapse of the condition.

2. Azathioprine (Imuran)

When treatment with “power pills” or “steroids” is ineffective, or to reduce the long-term side effects of steroids, this medication may be considered as an immunosuppressive therapy. Its mechanism of action involves inhibiting lymphocyte proliferation to reduce the production of autoantibodies. Imuran typically takes effect slowly; therapeutic benefits usually become apparent only after approximately 3–12 months of continuous treatment.

Side Effects

Leukopenia, anemia, thrombocytopenia, and abnormal liver function. Regular blood tests are required for monitoring. A few studies have reported that long-term use may increase the risk of certain cancers.

◎ Precautions

① Avoid vaccination with live-attenuated vaccines.

② Regular blood tests to monitor blood cell counts and liver function are required after treatment.

③ Since this is a different type of immunosuppressant from mycophenolate mofetil (CellCept), a physician must evaluate whether they can be used together; generally, they are not often used concurrently.

3. Mycophenolate mofetil (CellCept)

This is an immunosuppressive drug that inhibits purine nucleotide synthesis, suppresses lymphocyte proliferation, and reduces the production of autoantibodies. It is commonly used in clinical practice for long-term immunomodulatory treatment of myasthenia gravis, particularly when corticosteroids are insufficient, when corticosteroid doses need to be reduced, or when there is intolerance to azathioprine. The drug takes time to take effect, and therapeutic benefits usually become apparent only after several months of continuous treatment.

Side Effects

Common side effects include gastrointestinal discomfort (such as nausea, diarrhea, stomach pain, and indigestion) and headaches. Due to its immunosuppressive effects, it may increase the risk of infection. In rare cases, allergic reactions may occur, such as facial swelling, difficulty breathing, or unusual bruising or bleeding. Blood tests should be performed regularly during treatment to monitor blood cell counts and liver and kidney function.

4. Tacrolimus (Prograf/Advagraf)

A calcineurin inhibitor, it suppresses T-cell activation and cytokine production, thereby reducing autoimmune responses. In the treatment of myasthenia gravis, it is often used as an option when corticosteroids are insufficient, when corticosteroid doses need to be reduced, or when there is a poor response to other immunosuppressants. This medication takes effect relatively quickly, with some patients showing improvement within 1–3 months. Blood drug concentrations must be monitored regularly during treatment to maintain them within the appropriate therapeutic range.

Side effects

Common side effects include hand tremors, headaches, nausea, diarrhea, and insomnia. Elevated blood sugar, diabetes, hypertension, and hyperkalemia may also occur. In rare cases, renal Function may be affected; regular blood tests are required during treatment to monitor renal function and electrolyte levels.

5. Cyclosporine

A calcineurin inhibitor that suppresses T-cell activation and reduces autoimmune responses. In the treatment of myasthenia gravis, it serves as one of the immunosuppressive treatment options, particularly when corticosteroids are ineffective or when a reduction in corticosteroid dosage is required. Some patients may see therapeutic effects approximately 1–2 months after starting treatment. When used in combination with steroids, it may help reduce the steroid dosage.

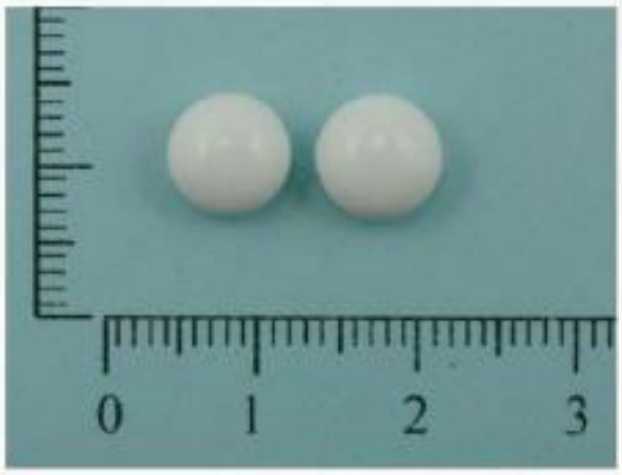
Side Effects

Common side effects include nausea, vomiting, sensory abnormalities (such as numbness or tingling), abnormal liver function, and effects on kidney function. It may also cause an increase in blood pressure. Regular monitoring of kidney function, liver function, and blood pressure is required during treatment.

6. Cyclophosphamide

This is an alkylating agent-based immunosuppressant that suppresses rapidly dividing immune cells, including T and B lymphocytes. Clinically, it is primarily used in patients with myasthenia gravis who have severe disease or who have not responded well to other immunosuppressive therapies.

It is a potent immunosuppressant and should be used only after careful evaluation by a specialist. The therapeutic effect usually becomes apparent gradually over a period of several weeks to several months.



Side Effects

Possible side effects:

- Bone marrow suppression.
- Increased risk of infection. Nausea, vomiting, hair loss.
- Hemorrhagic cystitis (blood in the urine).
- Long-term use may affect fertility.
- In rare cases, increased risk of certain types of cancer.

7. Rituximab (MabThera)

A monoclonal antibody targeting human CD20, it selectively eliminates B lymphocytes and reduces the production of autoantibodies. This medication may be considered for patients with refractory or recurrent myasthenia gravis when conventional immunosuppressive therapy has been ineffective.

It must be administered intravenously in a hospital setting under the supervision of medical personnel. Some patients may see therapeutic effects within approximately 1–3 months after treatment, though the actual time to response varies from person to person.

Side Effects

Common side effects include infusion reactions, which may include:

- Fever, chills, or shivering.
- Flu-like symptoms.
- Headache or fatigue.
- Flushing, nausea, rash, or itching.

In rare cases, difficulty breathing or severe allergic reactions may occur; close monitoring is required during administration. This medication may reduce B-cell counts, increasing the risk of infection; evaluation by a physician and regular follow-up are necessary.

New Biologics

Biologics are a class of protein-based medications produced using biotechnology that can more precisely modulate the immune system. Unlike traditional immunosuppressive drugs, these medications primarily target specific immune pathways to reduce the impact of autoantibodies on neuromuscular junctions.

Currently, the following types are primarily used in clinical practice:

1. Complement Inhibitors

Representative drugs: Eculizumab/Ravulizumab

Mechanism of Action: Blocks the activation of the complement system, reducing damage to the neuromuscular junction.

Indications: Patients who are acetylcholine receptor antibody-positive and have not responded well to conventional treatments.

2. FcRn Inhibitors

Representative Drugs: Efgartigimod/Rozanolixizumab

Mechanism of action: Accelerates the metabolism of autoantibodies in the body, thereby reducing antibody levels.

Indications: Patients who are acetylcholine receptor antibody-positive and have not responded well to conventional treatments, experience significant side effects from steroids and require a reduction in dosage, or have recurrent exacerbations or unstable symptom control.

3. B-Cell-Depleting Therapy

Representative Drugs: Rituximab/Inebilizumab

Mechanism of Action: Reduces the number of B lymphocytes that produce autoantibodies.

Indications: Certain patients with refractory or recurrent myasthenia gravis.

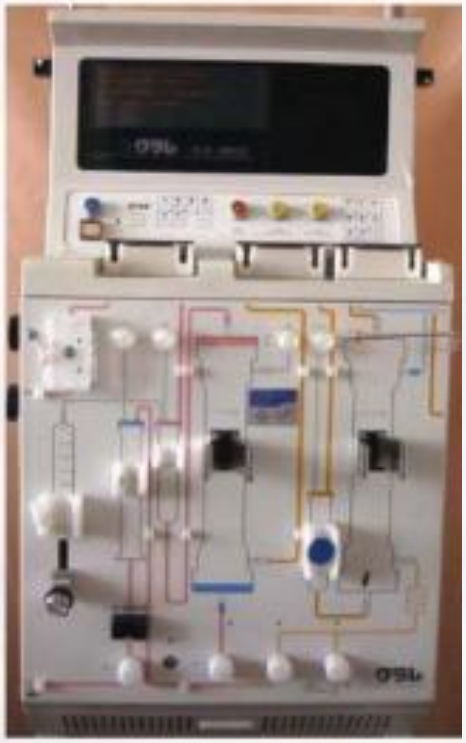
New biologics represent an important therapeutic direction that has emerged in recent years, but they are not suitable for all patients. Treatment options should be determined by a specialist based on antibody type, disease severity, and treatment response. Some medications are still under evaluation for national health insurance coverage; actual use must follow the physician’s recommendations and relevant regulations.

III. Plasma Exchange

This is a short-term treatment used during the acute phase to rapidly reduce antibody levels in the body. It includes:

1. Plasma Exchange: Blood is drawn from the patient, and blood cells are separated from plasma through centrifugation or filtration. The plasma containing autoantibodies is removed, and albumin solution or an appropriate replacement fluid is then infused.
2. Dual-filter plasma exchange: This method uses a special filter membrane to remove antibodies from the plasma, after which the treated plasma is returned to the body.

The treatment course typically lasts about 1–2 weeks and can rapidly reduce antibody levels in the body. It is commonly used in situations requiring rapid symptom relief, such as respiratory distress, acute exacerbations, or prior to thymus surgery. The effects are generally temporary, usually lasting only a few weeks to 1–2 months; therefore, adjustments to other immunotherapy strategies are still required.



◎ Treatment Overview

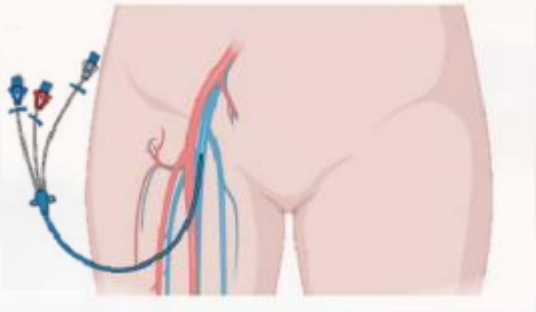
The plasma exchange regimen is scheduled by the physician based on the patient's condition. A typical course consists of about 5 sessions, each lasting approximately 2–3 hours, usually conducted every other day. If necessary, the physician may adjust the schedule to once daily.

◎ Treatment Location

Treatment is usually performed at a hemodialysis center. The center has dedicated nurses responsible for operating the equipment and providing comprehensive care throughout the process. It is equipped with ECG and automated blood pressure monitoring devices to ensure a safe and stable treatment process, allowing patients to undergo treatment with peace of mind.

◎ Establishing a Vascular Access (Placement of a Dual-Lumen Catheter)

Prior to plasma exchange, the physician will insert a thin tube into a blood vessel in the neck or groin under local anesthesia to serve as the vascular access for the treatment period. The placement procedure takes about 20–30 minutes and may cause slight discomfort, but it is generally tolerable. The catheter will be removed after the entire treatment course is completed. If you already have an artificial vascular access, treatment can be performed directly through it.



◎ Precautions Following Dual-Lumen Catheter Placement

Please pay special attention to the following during treatment:

- Avoid getting the catheter site wet during treatment. It is recommended to clean your body by sponging.
- Avoid strenuous activity or pulling on the catheter. If the catheter is placed in the groin, avoid taking large strides or bending excessively.
- If you experience persistent bleeding, fever, chills, or redness, swelling, heat, or pain around the catheter, please notify the medical staff immediately.
- The catheter must be properly secured; do not remove or adjust it yourself.
- Avoid putting pressure on the catheter site while sleeping.

◎ During plasma separation therapy

Please relax during the procedure and follow the instructions of the dedicated nurse. If you experience any discomfort during the process, such as dizziness, nausea, chest tightness, or other unpleasant sensations, please inform the medical staff immediately.

◎ After Treatment

- After the treatment is complete, please rest in bed for at least 30 minutes to prevent falls caused by temporary low blood pressure or dizziness.
- If a dual-lumen catheter is placed, the nursing staff will assist with catheter care. Please avoid excessive movement of the neck or lower limbs to prevent bleeding or displacement at the catheter site.
- Once the entire treatment course is complete and your coagulation function is assessed as normal, the physician will arrange for the catheter to be removed. After removal, local pressure will be applied to stop bleeding and reduce the risk of hemorrhage.

IV. Intravenous Immunoglobulin (IVIG)

Intravenous immunoglobulin involves the intravenous infusion of human immunoglobulin (IgG) into the body. These antibodies help regulate immune system function and reduce the impact of autoantibodies on the neuromuscular junction.

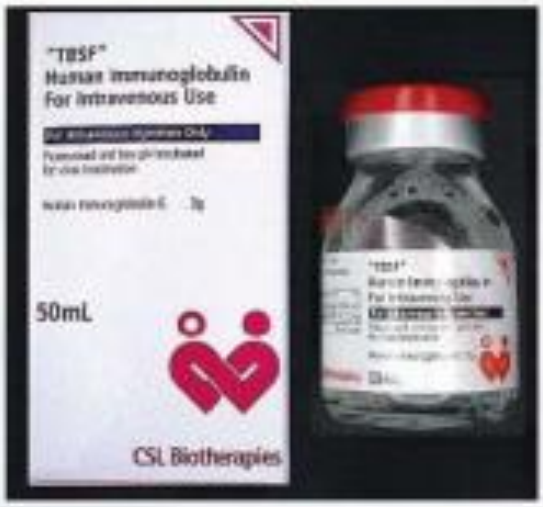
This is a short-term treatment method commonly used for acute exacerbations, preoperative preparation, or situations requiring rapid symptom improvement. The therapeutic effect is similar to that of plasmapheresis, but the procedure is more convenient and generally has fewer side effects.

The standard course of treatment consists of 5 consecutive days, with each daily infusion administered via slow intravenous infusion.

◎ Possible Side Effects

Most side effects are mild and usually resolve on their own after rest or by slowing the infusion rate. Examples include:

- Fever.
- Fatigue.
- Headache.
- Flushing or itching of the skin.



◎ Comparison of Immunoglobulin and Plasma Separation

	Immunoglobulins	Plasma fractionation
Advantages	1. More comfortable 2. Administered via a standard intravenous line, reducing the need for additional tubing and minimizing the risk of infection	1. Faster onset of action 2. Used when there are contraindications to immunoglobulin
Disadvantages	1. Requires hospitalization for administration* 2. Use with caution in patients with impaired cardiac or renal function	1. Requires a multidisciplinary team 2. May cause blood pressure fluctuations
Effectiveness	Equally effective in treating worsening muscle weakness Effective for short-term treatment of respiratory failure or dysphagia Prevents temporary exacerbations associated with increased steroid use	
Special circumstances		
Ocular Myasthenia Gravis	Efficacy is uncertain	Effective
MuSK	Poor efficacy	Effective
Recurrent	For maintenance therapy	For rapid disease progression

*For patients who are difficult to treat or cannot use immunotherapy, immunoglobulin may be considered as maintenance therapy

V. Thymectomy

In healthy adults, the thymus gradually atrophies with age and is replaced by fatty tissue. However, in patients with myasthenia gravis, the thymus often exhibits abnormal changes; approximately 10–20% may have thymic tumors, while 70–80% present with benign thymic hyperplasia. The thymus is believed to be involved in the production of autoantibodies; therefore, the goal of thymectomy is to reduce abnormal immune responses and thereby improve disease control. Studies have shown that in some patients, levels of acetylcholine receptor antibodies decrease following thymectomy. Overall, most suitable patients experience varying degrees of symptom improvement.

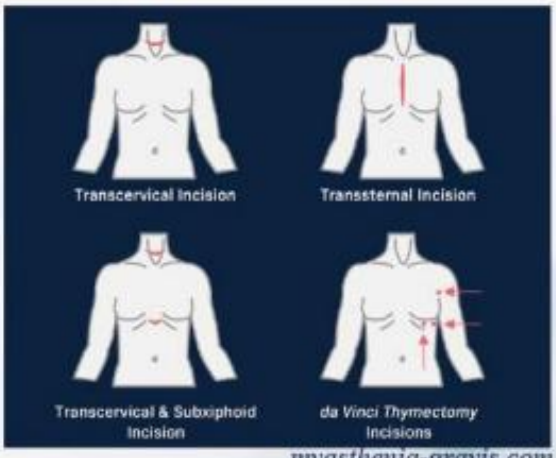
The decision to undergo thymectomy depends on the patient's age, the type of antibodies, the presence of a thymic tumor, and the severity of the condition, and is determined through a joint assessment by neurologists and thoracic surgeons.

◎ How is a thymectomy performed?

The surgical approach for thymectomy varies depending on the patient's condition and the location of the tumor, including:

1. Transcervical thymectomy: Performed through a small incision in the neck.
2. Transsternal thymectomy: The traditional approach, performed through a midline incision in the sternum.
3. Transcervical combined subxiphoid resection: Performed through incisions in the neck and below the sternum (subxiphoid).
4. Minimally invasive surgery (video-assisted thoracoscopic surgery [VATS] or robot-assisted surgery): Performed through several small incisions using a camera and surgical instruments under image guidance. In robot-assisted surgery, the surgeon operates robotic arms to perform the procedure.

Minimally invasive surgery typically results in smaller incisions, less postoperative pain, and a faster recovery time. The most appropriate surgical approach must be determined by a thoracic surgeon based on the patient's individual circumstances.



VI. Advanced Treatment for Thymoma

The primary treatment for thymoma is surgical resection. The specific surgical approach is determined by the physician following an assessment of the tumor's size, location, medical history, and the patient's overall health.

Preoperative Preparation To reduce the risk of complications during and after surgery, the physician may recommend the following prior to surgery:

- Intravenous immunoglobulin (IVIG).
- Plasma exchange to stabilize the condition and reduce the risk of worsening muscle weakness.

◎ Postoperative Treatment

The need for further treatment after surgery will be determined based on the stage of the thymoma and the pathology results, including: Adjuvant radiation therapy and chemotherapy.

For more advanced or recurrent thymomas, other treatment options may be considered, such as photodynamic therapy or hyperthermic chemotherapy. The actual treatment plan must be determined following a joint assessment by thoracic surgeons and oncologists.

VII. Discharge Care Instructions

I. Home Self-Care

Diet

① Food should be cooked until very soft to make it easier to chew and swallow. Eat small amounts frequently, taking small bites and eating slowly.

② Take medication approximately 30 minutes before meals as directed by your doctor; this can help improve muscle strength, making chewing and swallowing easier.

③ Maintain a balanced diet, eat plenty of vegetables and fruits, and drink an adequate amount of water to prevent constipation.

④ If food gets stuck, difficulty swallowing worsens, or excessive phlegm affects breathing, stop eating immediately. If you have a suction device at home, you may assist with suctioning if it is safe to do so; if symptoms do not improve or if you experience difficulty breathing, seek medical attention as soon as possible.

Nasogastric Tube Care

If the nasogastric tube must remain in place upon discharge, the hospital will arrange for a dietitian and home care nurse to meet with you and your family prior to discharge. They will explain feeding methods, tube care, and precautions to ensure safety at home.

Bowel and Bladder Care

① Try to use the restroom on your own as much as possible. We recommend installing grab bars in the bathroom to prevent falls.

② If you need to urinate frequently but lack the energy to get up, you may temporarily use a bedpan or urinal in bed.

③ If reduced physical activity or food intake is affecting bowel movements, moderately increase your intake of fruits, vegetables, and fluids, and engage in appropriate physical activity as your strength allows.

④ Establish a routine of using the restroom at fixed times, or perform gentle abdominal massages to help promote bowel movements.

Rest and Exercise

Since everyone's physical condition and medical situation differ, exercise routines should be adjusted according to individual circumstances. The general principle is to avoid excessive fatigue and to exercise within your limits. Types of exercise to consider include:

① Light to moderate aerobic exercise: such as walking, slow cycling, or swimming, which helps maintain cardiovascular function.

② Stretching exercises: These help maintain joint mobility and flexibility.

③ Yoga or breathing exercises: These help with relaxation and body control.

④ Light to moderate resistance training: Helps maintain muscle strength within safe limits.

⑤ Balance training: Reduces the risk of falls.

If you experience significant fatigue, decreased muscle strength, difficulty swallowing, or breathing difficulties during exercise, stop immediately and rest. Before starting or adjusting an exercise plan, please consult your doctor to ensure safety.

Other Tips

① Avoid overexertion while working or doing household chores. If you feel tired, take a break when needed. It is generally recommended to take a short break after working for about 2–3 hours.

② Maintain a regular daily routine and get adequate sleep; avoid staying up late for extended periods or experiencing excessive stress. If you have trouble sleeping, please discuss this with your doctor; do not take sleeping pills on your own.

③ Maintain a calm state of mind and avoid prolonged emotional tension or excessive stress to reduce the risk of fluctuations in your condition.

④ Wear a mask when going out and avoid contact with people who have cold or infectious disease symptoms to reduce the risk of infection.

⑤ Regularly monitor your blood pressure and weight to help track changes in your physical condition.

⑥ Avoid smoking and limit alcohol consumption to maintain overall health.

⑦ Take prescribed medications on time and attend regular follow-up appointments as scheduled by your doctor.

II. Common Causes of Relapse or Worsening

The following situations may trigger a recurrence of myasthenia gravis or worsen symptoms:

① Fever or infection (such as the common cold, pneumonia, etc.).

② Failure to take medication as prescribed or stopping medication on your own.

③ Use of medications that may affect neuromuscular transmission.

④ Surgery, trauma, or significant physical stress.

⑤ Prolonged excessive physical exertion or severe mental stress.

⑥ Physiological changes during menstruation or around the time of pregnancy.

⑦ Recurrence of a thymoma.

⑧ Thyroid dysfunction.

⑨ In a small number of patients, cancer immunotherapy drugs may also trigger or exacerbate myasthenia gravis.

Sometimes the cause of symptom worsening is unclear and may be related to fluctuations in the disease itself.

III. Symptoms Requiring Immediate Medical Attention

If any of the following occur, please seek medical attention or return for a follow-up visit as soon as possible:

① Signs of infection: Persistent high fever, chills, severe cough, or worsening weakness.

② Significant worsening of muscle weakness: Difficulty breathing, inability to cough up phlegm, frequent choking, or worsening difficulty swallowing. If symptoms suddenly worsen, affecting daily activities or making it impossible to perform basic daily tasks, seek medical attention immediately.

③ Possible Overdose or Side Effects: Significant worsening of muscle weakness, abdominal cramps, severe diarrhea, or excessive drooling, among other abnormal symptoms.

IV. Medication Precautions

① When seeking medical care for other conditions, you should proactively inform your doctor that you have myasthenia gravis. You may also carry a "Prohibited Medication" card to avoid medications that may affect neuromuscular transmission.

② If symptoms are more pronounced in the morning, keep that day's dose of medication and water by your bedside so you can take it promptly upon waking.

③ When going out, keep your medication in the car or in your bag to avoid forgetting to take it.

④ If you have difficulty swallowing, you may crush the tablets and mix them into semi-solid food. Please confirm first whether the medication is safe to crush.

⑤ Do not stop taking your medication or adjust the dosage without a doctor's evaluation.

⑥ Consult your doctor before taking medications or dietary suppleme

Medications to Be Aware Of

Medications that affect the neuromuscular junction

◎ Antibiotics:

- Aminoglycosides: Gentamicin, Amikacin, Netilmicin, Tobramycin, Streptomycin, Kanamycin, Neomycin
- Fluoroquinolones: Ciprofloxacin, Levofloxacin, Moxiloxacin
- Macrolides: Erythromycin, Azithromycin, Clarithromycin
- Telithromycin, Quinine

◎ Cardiovascular drugs:

- Antiarrhythmic drugs: Procainamide, Bretylium, Trimethaphan
- Beta-blockers: Propranolol, Oxprenolol, Timolol, Practolol, Atenolol, Labetaolol, Metoprolol, Nadolol
- Calcium channel blockers: Verapamil

Medications that affect the neuromuscular junction (continued)

◎ Ophthalmic Drugs: Timolol maleate eye drops

◎ Neuromuscular blocking agents:

- Succinylcholine
- Vecuronium
- Botulinum toxin

◎ Immune checkpoint inhibitors

- Pembrolizumab
- Nivolumab
- Atezolizumab
- Avelumab
- Durvalumab
- Ipilimumab

◎ Other drugs:

- Interferon-alpha
- D-penicillamine

If you experience any adverse effects from using the above medications, please seek medical attention immediately.

VIII. Vaccination Guidelines

I. Introduction to Vaccine Types

Vaccines can generally be divided into three major categories:

① Live-attenuated vaccines: These contain a weakened form of the virus that briefly replicates in the body after vaccination to produce immunity. Examples include BCG, oral polio vaccine, measles, mumps, rubella, varicella, Japanese encephalitis (some strains are live-attenuated), yellow fever, dengue fever (for specific populations), and shingles (Zostavax).

② Inactivated vaccines: These vaccines are inactivated and contain no live virus. They include diphtheria, pertussis, tetanus, cholera, injectable polio, rabies, hepatitis A and B, Haemophilus influenzae type b (Hib), influenza, pneumococcal, human papillomavirus (HPV), and shingles (Shingrix, a recombinant vaccine).

③ Novel vaccines: Produced using different biotechnological methods, such as adenovirus vector vaccines (e.g., AstraZeneca COVID-19), mRNA vaccines (e.g., Pfizer and Moderna COVID-19), and recombinant protein vaccines (e.g., Novavax and Medigen).

II. Considerations for Receiving Vaccines

① Patients not taking immunosuppressants:

In general, most vaccines can be administered according to standard recommendations. However, you should still inform your doctor of your medical condition so that the timing of vaccination can be assessed.

② Patients currently taking immunosuppressants:

- Inactivated vaccines (e.g., influenza vaccine, pneumococcal vaccine, HPV vaccine, etc.): These are generally safe to receive.
- Live-attenuated vaccines: Special caution is required, and vaccination may not be recommended in some cases.

③ Since immunosuppressive therapy reduces the body's immune response, antibody levels produced after vaccination may be lower, and protection may be less effective than in the general population. Additionally, receiving live-attenuated vaccines while the immune system is compromised may theoretically increase the risk of infection.

④ Regarding booster doses of live-attenuated vaccines: Most individuals have completed the primary series of these vaccines by preschool age. The need for a booster should be determined based on the individual's immune status and a physician's assessment; booster doses are not appropriate in all situations.

III. Vaccination Precautions When Taking Immunosuppressants

① In general, patients currently taking immunosuppressants are not recommended to receive live-attenuated vaccines, including the yellow fever vaccine, the dengue vaccine, and other live-attenuated vaccines requiring a first dose.

② Since immunosuppressive therapy lowers the body's resistance, patients are more susceptible to infections, particularly respiratory infections, and the infection itself may trigger a worsening of myasthenia gravis symptoms. Therefore, it is recommended to receive influenza and pneumococcal vaccines as advised by a physician. Currently, there is no clear evidence that these inactivated vaccines exacerbate myasthenia gravis symptoms.

③ The traditional shingles vaccine, Zostavax, is a live attenuated vaccine; its use should be carefully evaluated in immunocompromised individuals. The newer Shingrix is an inactivated recombinant vaccine with a higher safety profile and may be administered as recommended by a physician.

IV. COVID-19 Vaccination Guidelines

① Patients with autoimmune diseases (such as myasthenia gravis) who contract COVID-19 may face an increased risk of complications and disease progression; therefore, vaccination plays a crucial protective role in preventing severe illness.

② Current international guidelines indicate that approved COVID-19 vaccines (such as mRNA vaccines and protein subunit vaccines) are generally safe for most patients with myasthenia gravis. Available evidence does not suggest that any one vaccine is significantly superior to others.

③ Vaccination is recommended when the condition is stable and symptoms are well-controlled. Some potent immunosuppressive medications may affect vaccine efficacy; whether temporary medication adjustments are necessary should be assessed by a physician on a case-by-case basis. Do not stop taking medication on your own.

④ It is recommended to discuss the matter thoroughly with a physician prior to vaccination and to schedule the vaccination in accordance with the individual's condition and treatment plan.

V. Treatment Principles for Myasthenia Gravis Patients During Hospitalization

① Steroid therapy should not be abruptly discontinued. Avoid sudden discontinuation of steroids; during periods of increased physical stress (such as infection, surgery, or critical illness), the dosage may need to be adjusted appropriately based on clinical circumstances.

② Immunosuppressants should not be discontinued without careful consideration. Unless there are special circumstances or the decision has been discussed with a neuromuscular specialist, immunosuppressive therapy should not be stopped on one's own or arbitrarily.

③ The risks of infection and treatment must be carefully weighed. Decisions to initiate or adjust immunosuppressive therapy should be based on an individualized assessment that balances the risk of infection against the risk of disease progression that may result from delayed treatment.

④ Hospital-based treatments should generally not be arbitrarily interrupted. Treatments that must be administered in a hospital setting (such as intravenous immunoglobulin [IVIG] or rituximab) should generally not be delayed or discontinued without cause, unless there are clear medical reasons.

VI. Safety Classification of Commonly Used Dental Medications

This table classifies common dental medications into three categories based on their potential impact on myasthenia gravis:

① Relative Contraindication: May significantly exacerbate myasthenia gravis symptoms; use should be avoided whenever possible.

② Use with Caution: May affect respiratory or neuromuscular function; if use is necessary, administer at low doses under monitoring, and closely observe changes in respiration and muscle strength.

③ Relatively Safe: Clinical experience and literature indicate that these drugs are generally safe for use, but individual patient conditions should still be evaluated.

Category	Relative Contraindications	Use with caution	Relatively safe
Local anesthetics	Procaine (ester-type)	Lidocaine, Mepivacaine, Bupivacaine, Prilocaine	
Analgesics		Morphine and its derivatives, Narcotics	Acetaminophen, NSAIDs, Aspirin
Sedatives/ Sleep Aids		Benzodiazepines, Hypnotics, Barbiturates	Nitrous oxide (N_2O/O_2 sedation)
Antibiotics	Erythromycin, Gentamicin, Neomycin, Polymyxin B, Bacitracin, Clindamycin	Metronidazole, Tetracycline, Vancomycin	Penicillin and its derivatives
Other medications		Corticosteroids	

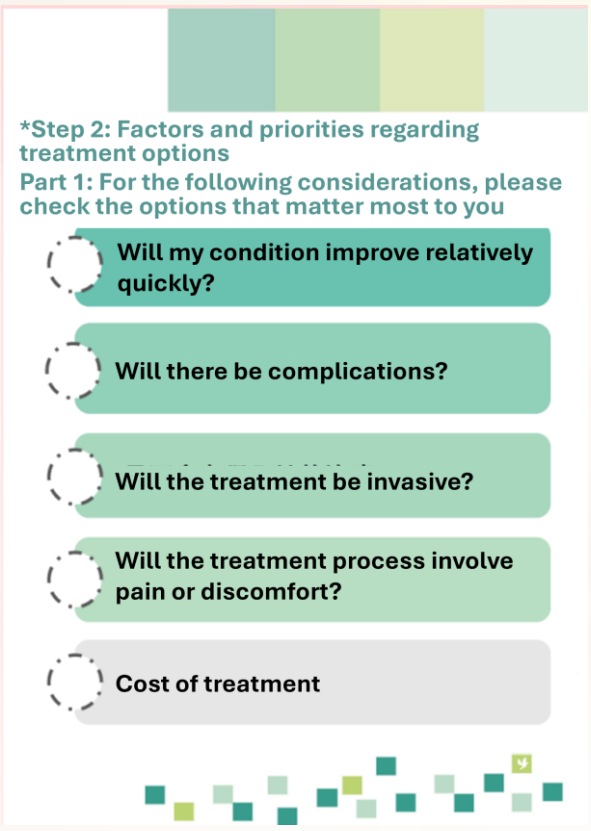
IX. Shared Decision Making

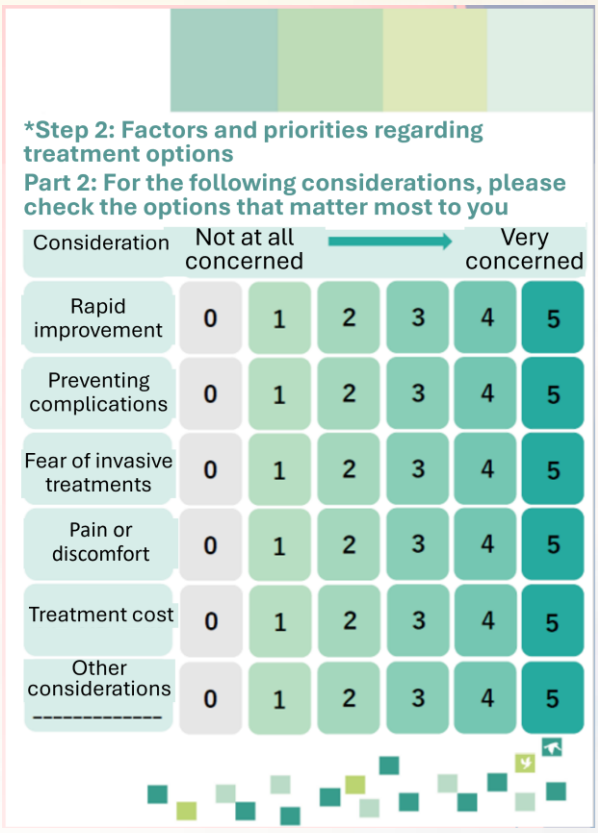
◎ Shared Decision Making (SDM) is a treatment decision-making model in which both the physician and the patient participate. The physician provides professional information on different treatment options, while the patient expresses personal considerations and treatment expectations. Through thorough communication and information exchange between both parties, they jointly select the most appropriate and feasible treatment plan.

◎ In cases of acute exacerbation of myasthenia gravis or life-threatening situations, treatment decisions may need to be made within a short timeframe. In such instances, the medical team will prioritize addressing the emergency based on professional judgment while, when circumstances permit, explaining and discussing the treatment plan with the patient and family members to the greatest extent possible.

◎ Since patients with myasthenia gravis are prone to anxiety and stress due to fluctuations in their condition, establishing effective doctor-patient communication before treatment and confirming their understanding of the treatment details and potential risks are particularly important for enhancing trust in the treatment and improving patient compliance.

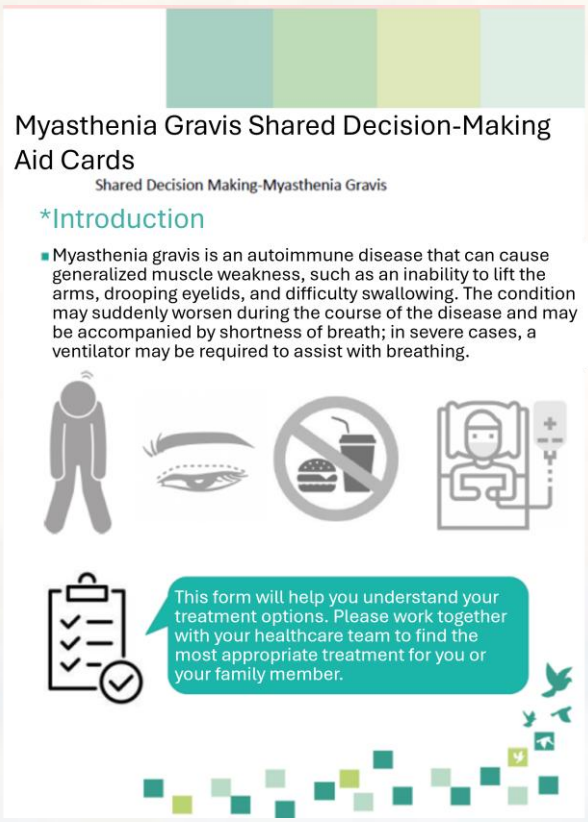
Shared Decision-Making Aid Cards for Myasthenia Gravis

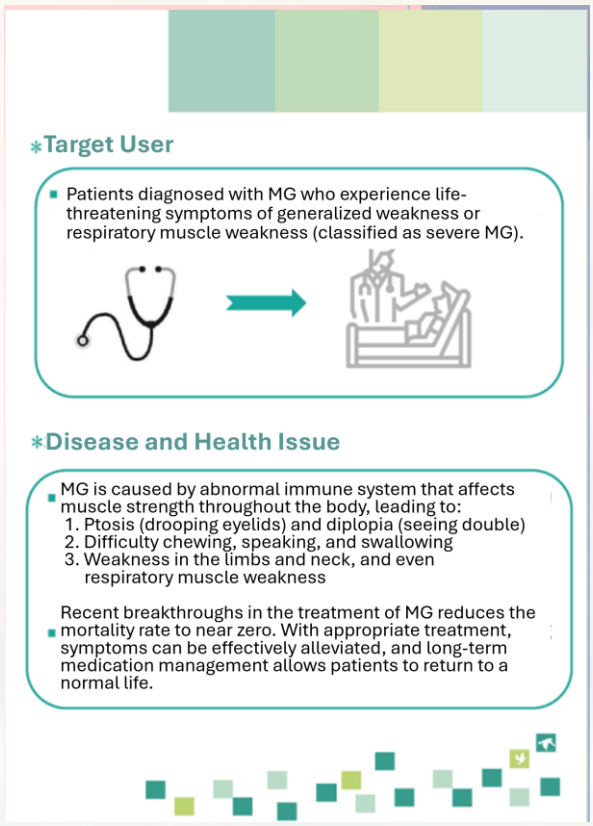


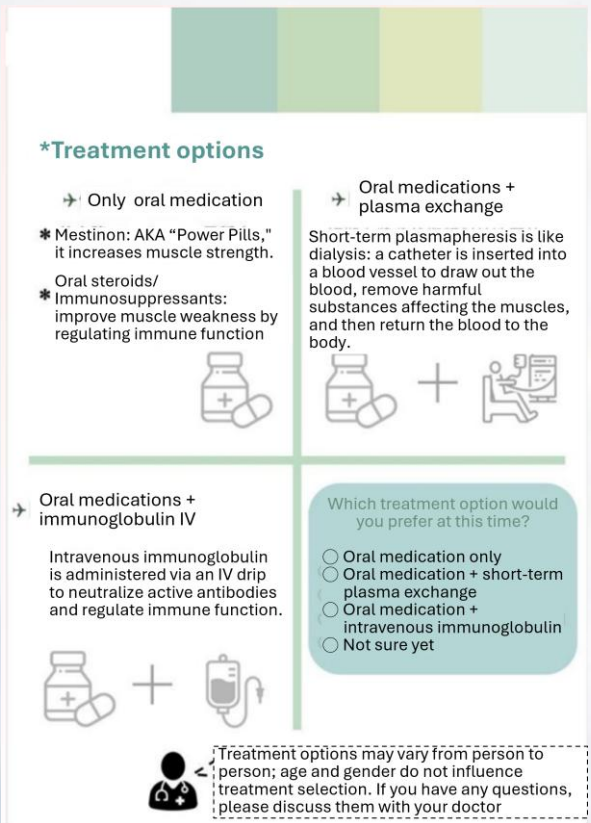


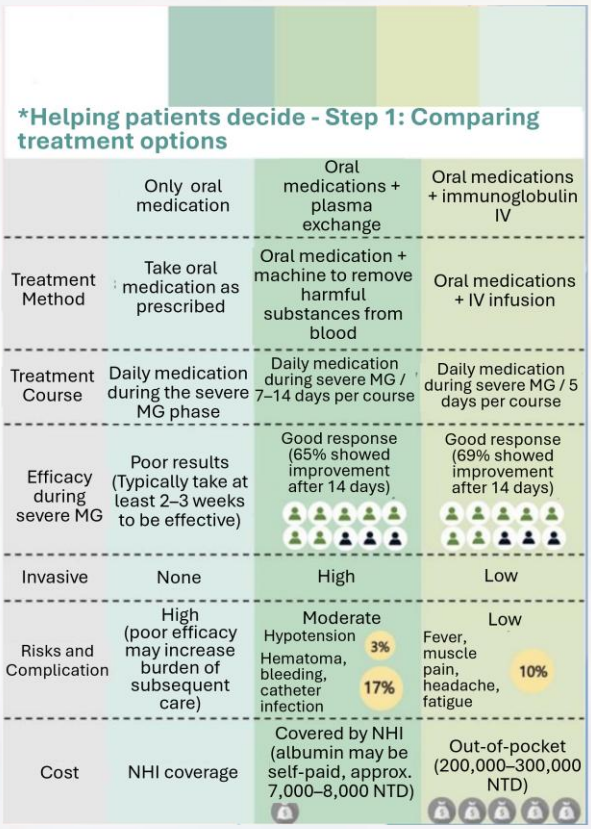
Source: Formosan Journal of Medicine 2021, Vol. 25, No. 1; Fu Jen Catholic University Hospital website

Shared Decision-Making Aid Cards for Myasthenia Gravis









	Only oral medication	Oral medications + plasma exchange	Oral medications + immunoglobulin IV
Treatment Method	Take oral medication as prescribed	Oral medication + machine to remove harmful substances from blood	Oral medications + IV infusion
Treatment Course	Daily medication during the severe MG phase	Daily medication during severe MG / 7–14 days per course	Daily medication during severe MG / 5 days per course
Efficacy during severe MG	Poor results (Typically take at least 2–3 weeks to be effective)	Good response (65% showed improvement after 14 days)	Good response (69% showed improvement after 14 days)
Invasive	None	High	Low
Risks and Complication	High (poor efficacy may increase burden of subsequent care)	Moderate: Hypotension 3%; Hematoma, bleeding, catheter infection 17%	Low: Fever, muscle pain, headache, fatigue 10%
Cost	NHI coverage	Covered by NHI (albumin may be self-paid, approx. 7,000–8,000 NTD)	Out-of-pocket (200,000–300,000 NTD)

Source: Formosan Journal of Medicine 2021, Vol. 25, No. 1; Fu Jen Catholic University Hospital website

X. Conclusion

◎ There is currently no cure for myasthenia gravis. However, with appropriate treatment and regular follow-up, the condition can be well-managed in most patients. Even during periods of stability or remission, the course of the disease may experience slight fluctuations, which can occur on an annual, monthly, or even daily basis; however, many patients are able to maintain a relatively stable condition over the long term.

◎ Emotions and stress can have a significant impact on the condition. Excessive excitement, anxiety, or depression may cause a temporary worsening of symptoms. Therefore, maintaining a regular lifestyle, getting adequate rest, and practicing good mental adjustment can help stabilize the condition.

◎ Although myasthenia gravis is a chronic condition, thanks to medical advances and personalized treatment, over 90% of patients can maintain their daily functional abilities, including academic pursuits, work, marriage, and childbearing. Some patients may even achieve long-term stable remission.

◎ Understanding potential triggers for disease exacerbation and working closely with your physician are key to achieving long-term stability.

Appendix: Myasthenia Gravis Resources

◎ New Taipei City Myasthenia Gravis Center (Shuang Ho + Fu Jen Catholic University Hospital)

◎ YOULI - Myasthenia Gravis Companion Association

◎ Taiwan Myasthenia Gravis Care Association http://www.fmg.org.tw

◎ Shin Kong Wu Ho-Su Memorial Hospital - Myasthenia Gravis Center

◎ Show Chwan Memorial Hospital – Myasthenia Gravis Center www.scmh.org.tw

◎ Taoyuan Hospital - Myasthenia Gravis Center www.tygh.mohw.gov.tw

◎ Kaohsiung Chang Gung Memorial Hospital www.cgmh.org.tw/tw

◎ Tainan Chi Mei Medical Center www.chimei.org.tw

◎ Miaoli Da Chien Hospital www.dachien.com.tw

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