

Myasthenia Gravis

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THE STORY IN ONE SENTENCE

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“Myasthenia gravis means your immune system attacks the docking stations where nerve messages land on muscle — so muscles get weaker the more you use them, then bounce back with rest.”

Normal anatomy — the body's job

A motor nerve ending releases acetylcholine (a chemical messenger) into the synaptic cleft (a microscopic gap) between the nerve and muscle. Acetylcholine floats across and lands on acetylcholine receptors (docking stations) clustered on the muscle membrane. When enough receptors catch acetylcholine, they open sodium channels (gates for charged particles), sodium rushes in, the muscle membrane depolarizes (flips its electrical charge), and that electrical wave travels deep into the fiber to trigger contraction. Keep this picture in your head, because every weird finding in myasthenia gravis is a downstream effect of breaking this handshake.

BODY'S JOB

The neuromuscular junction's job is to translate the nerve's electrical decision ('contract now') into a chemical message (acetylcholine) that crosses the gap and becomes an electrical wave inside the muscle, so your brain's command turns into movement. Without this relay, nerves and muscles cannot talk, and you cannot move on purpose.

1. The motor neuron (nerve cell that controls muscle) fires an action potential (electrical spike) down its axon (the long wire of the nerve).
2. The spike reaches the nerve terminal (the bulb-shaped end) and opens calcium channels.

3. Calcium floods in and makes vesicles (tiny bubbles filled with acetylcholine) fuse with the nerve membrane and dump acetylcholine into the synaptic cleft.
4. Acetylcholine molecules drift across the cleft in microseconds and bind to nicotinic acetylcholine receptors on the motor endplate (the receiving zone on the muscle fiber).
5. Each receptor is a doughnut-shaped protein with five subunits; when two acetylcholine molecules land on it, the center hole opens and lets sodium ions pour into the muscle.
6. This local sodium influx depolarizes the motor endplate, creating an endplate potential (a small electrical bump).
7. If enough receptors open at once, the endplate potential is big enough to trigger voltage-gated sodium channels in the nearby muscle membrane, launching a full action potential that races along the muscle fiber.
8. The action potential dives into the T-tubules (tunnels that reach deep into the muscle) and tells the sarcoplasmic reticulum (the muscle's calcium storage tank) to release calcium.
9. Calcium floods the contractile proteins (actin and myosin filaments), they slide past each other, and the muscle fiber shortens — you just moved.
10. Acetylcholinesterase (an enzyme in the cleft) quickly chops up leftover acetylcholine so the signal stops and the muscle can relax, ready for the next command.

What breaks

The immune system makes antibodies against the acetylcholine receptors on the muscle side of the junction. These antibodies block the receptor's acetylcholine-binding site, cross-link receptors so they clump and get pulled inside the cell for destruction, and tag receptors to speed their breakdown. The result is fewer working receptors on the muscle membrane. The first nerve signal still triggers contraction because there are enough receptors left to reach threshold. But with repeated signals, the safety margin shrinks — each contraction uses up more of the dwindling receptor pool, so the endplate potential gets smaller and smaller until it cannot trigger a muscle action potential. That is why strength fades with use and recovers with rest: rest gives the muscle time to recycle some receptors back to the surface and lets acetylcholine levels rebuild.

CLINICAL TERM

Autoantibodies (most commonly anti-acetylcholine receptor [anti-AChR] IgG, found in about 85 % of generalized and 50 % of ocular myasthenia gravis cases) bind to the nicotinic acetylcholine receptors at the motor endplate. They cause receptor internalization and degradation (by cross-linking receptors and triggering complement-mediated lysis), block acetylcholine binding sites, and reduce the density of functional receptors. About 5–10 % of seronegative patients have antibodies against muscle-specific kinase (anti-MuSK), a protein that clusters receptors; these patients often have more bulbar and respiratory weakness. A smaller fraction have antibodies to lipoprotein receptor-related protein 4 (LRP4), which helps organize the neuromuscular junction. The final common path is the same: the post-synaptic membrane has too few receptors to generate a reliable endplate potential, so the safety factor for neuromuscular transmission drops. Early in a train of stimuli, transmission succeeds; with repetition, the amplitude of successive endplate potentials declines (decremental response on repetitive nerve stimulation), and clinical weakness appears.

How the body compensates

In early or mild myasthenia gravis, the body has no direct way to make more acetylcholine receptors quickly or to turn off the autoantibodies, so there is no true physiologic compensation — the disease just oscillates between stable (when you rest and receptor density recovers slightly) and weak (when you use muscles and deplete the receptor reserve). Vital signs stay normal until respiratory muscles fail, which makes the pre-crisis phase deceptively calm. The clinical job is to track the trajectory — how fast weakness is spreading, whether rest restores strength fully, and whether breathing effort is rising — because once the respiratory reserve is gone, the patient crashes into myasthenic crisis and needs intubation within hours.

1. The body cannot grow new acetylcholine receptors fast enough to match antibody-mediated destruction, so there is no real compensation at the receptor level.
2. Patients instinctively rest the weak muscles — taking breaks, closing one eye to fix double vision, eating softer foods — which buys time by letting the remaining receptors recover from fatigue.
3. The nervous system may try to fire motor neurons more often to recruit more muscle fibers, but this strategy backfires because it accelerates receptor depletion and worsens fatigue.
4. Vital signs (heart rate, blood pressure, oxygen saturation on pulse oximetry) stay normal for a long time because the heart and automatic breathing reflexes are not affected by myasthenia gravis — only voluntary muscles that use nicotinic receptors (skeletal muscles) are hit.

5. This normal-looking vital-sign window is dangerous: a patient can look stable while silently losing respiratory reserve, then tip into respiratory failure suddenly when the diaphragm and intercostal muscles (the muscles between the ribs) cannot generate enough negative pressure to pull air in.
6. The crash point to watch is declining vital capacity (the total volume of air you can blow out after a full breath in; normal is roughly 65–75 mL/kg, crisis threatens below 15–20 mL/kg), weakening negative inspiratory force (NIF, the suction pressure you can create; normal is more negative than -60 cm H₂O, intubation often needed when it rises above -30 cm H₂O), rising respiratory rate with shallow breaths, use of neck muscles to breathe, difficulty speaking full sentences, and inability to cough or clear secretions.
7. Cholinergic crisis — weakness from too much acetylcholinesterase inhibitor medication (pyridostigmine) — looks clinically similar to myasthenic crisis but adds parasympathetic overdrive: tiny pupils (miosis), excessive saliva and tears (hypersecretion), cramping, diarrhea, sweating, and slow heart rate (bradycardia). It is much less common than myasthenic crisis in modern practice because dosing is carefully monitored.
8. Because compensation is minimal and the disease can swing rapidly, serial bedside measurements (how many seconds the patient can hold arms outstretched, count out loud, or keep eyes open without a drooping eyelid (ptosis) worsening) and twice-daily pulmonary function checks (vital capacity and NIF) are the real early-warning system.
9. A patient who looks stable today but whose vital capacity dropped 20 % since yesterday is on a cliff edge, even if oxygen saturation is still 98 % — do not wait for the oxygen to fall, because by then the muscles are exhausted and intubation is emergent rather than controlled.

Domino effect

1. Autoantibodies (anti-AChR, anti-MuSK, or anti-LRP4) attach to acetylcholine receptors or the proteins that organize them at the neuromuscular junction. — The immune system mistakenly flags these receptors as foreign invaders (the trigger is often a thymus gland abnormality — about 10–15 % of myasthenia gravis patients have a thymoma [thymus tumor], and 70 % have thymic hyperplasia [an overgrown thymus]; the thymus teaches immune cells what to attack, and when it is abnormal it can train antibodies to attack self-proteins like acetylcholine receptors).
2. Antibodies block acetylcholine binding, cross-link receptors for internalization, and activate complement to destroy the motor endplate, so the number of working receptors drops. — Fewer receptors means each nerve impulse releases the same amount of acetylcholine but fewer molecules find a landing spot, so the endplate potential (the electrical bump that starts muscle contraction) is smaller and closer to the threshold for failure.

3. The first muscle contraction works fairly well because the remaining receptors are rested and ready, but repeated contractions (looking side to side, chewing, holding your arms up) rapidly deplete the small acetylcholine reserve in the nerve terminal and exhaust the limited receptor pool. — Each contraction uses up some acetylcholine and temporarily desensitizes some receptors; normally the safety margin is huge, but in myasthenia gravis the margin is paper-thin, so the third or fifth contraction may fail to generate enough endplate potential to fire the muscle.
4. Eye muscles (the extraocular muscles that move the eyeball, and the levator palpebrae that lifts the eyelid) fail first, causing a drooping eyelid (ptosis) (droopy eyelid, often worse at the end of the day or after reading) and diplopia (double vision because the two eyes no longer aim together). — Eye muscles are tiny, fire constantly to track and focus, and have the smallest neuromuscular safety margin in the body — they run on a lean receptor budget even when healthy, so any receptor loss shows up as weakness immediately. About 50 % of patients present with purely ocular symptoms, and 85 % have eye involvement at some point.
5. Bulbar muscles (the muscles of the face, throat, and tongue) weaken next, so speech becomes nasal or slurred (dysarthria, especially for long words or after talking for a while), chewing tires the jaw (you may need to prop your jaw with your hand halfway through a meal), and swallowing becomes unsafe (dysphagia, with risk of choking or aspiration because food or liquid slips into the airway). — Bulbar muscles are also small, work continuously (you swallow every few minutes even at rest, and talking requires fast, coordinated firing), and have less reserve than big limb muscles, so they hit the receptor floor early in the disease.
6. Proximal limb muscles (shoulders, hips) and neck extensors weaken, making it hard to lift arms overhead (combing hair, reaching a high shelf), climb stairs, stand from a chair, or hold the head up (the head may drop forward after sitting upright for a while). — These large muscles have more receptors and a bigger safety margin than eye or bulbar muscles, so they fail later — but once the disease is moderate or severe, even they cannot maintain force during sustained or repeated effort.
7. The diaphragm (the dome-shaped muscle under the lungs that does 70–80 % of the work of breathing) and the intercostal muscles (between the ribs) lose strength, so the patient cannot pull in a deep breath, vital capacity falls, and carbon dioxide starts to build up in the blood (hypercapnia). — Respiratory muscles are working every second and have no chance to rest, so when their receptor count drops below the critical threshold they simply cannot generate enough negative pressure to inflate the lungs — this is myasthenic crisis, the life-threatening emergency of myasthenia gravis, seen in about 15–20 % of patients at some point and requiring mechanical ventilation until treatment (plasmapheresis, intravenous immunoglobulin, or high-dose steroids) can reduce the antibody load and restore receptor function.

8. After rest (a nap, a night's sleep, or even just closing the eyes for a few minutes), strength partially returns because rested nerve terminals have rebuilt their acetylcholine stores and rested receptors have recovered from desensitization — but the underlying receptor shortage remains, so the fatigue pattern repeats with the next round of activity. — Fluctuating, fatigable weakness that improves with rest and worsens with repetitive use is the clinical signature of myasthenia gravis and distinguishes it from most other causes of weakness (which are usually constant or progressive rather than use-dependent).

Symptoms · what the patient feels, and why

- Drooping eyelid (ptosis) that gets worse when you look up for a long time: Acetylcholine receptors (the docking spots where nerve signals tell muscles to move) on the eyelid muscles are blocked by your own antibodies, so the signal fades quickly and the lid droops more and more as you use it.
- Double vision (diplopia) that comes and goes: The tiny muscles that move your eyes get weaker as you use them because antibodies block the acetylcholine receptors, so the eyes can't stay lined up and you see two images instead of one.
- Drooping or weak face muscles, especially when you chew, smile, or talk a lot: Face and jaw muscles depend on acetylcholine to fire, and when antibodies jam those receptors, the muscles tire out fast—your smile may fade or your jaw may droop mid-meal.
- Trouble swallowing (dysphagia) or slurred speech that gets worse as you talk: The muscles in your throat and voice box (bulbar muscles) use acetylcholine receptors to move; when antibodies block them, these muscles weaken with use, making words slur and food harder to push down.
- Arm or leg weakness that improves with rest and worsens with repeated movement: Antibodies block acetylcholine receptors on limb muscles, so the nerve signal gets weaker each time you lift or move—rest lets a few receptors recover, but the next round of movement fatigues them again.
- Trouble breathing or feeling short of breath, especially when lying flat or after activity: The diaphragm and chest-wall muscles (the muscles that pump air in and out) rely on acetylcholine; when antibodies block enough receptors, those muscles can't move air well, and you feel breathless or may stop breathing (myasthenic crisis).
- Sudden worsening of any muscle weakness triggered by infection, surgery, or certain drugs (aminoglycosides, fluoroquinolones, beta-blockers, magnesium): Infection stress and some drugs (aminoglycosides and fluoroquinolones jam the nerve-muscle junction further; beta-blockers and magnesium slow acetylcholine release) tip the balance when receptors are already scarce, so weakness spikes fast.

Focused exam

- Droopy eyelid that gets worse the longer you look up (fatigable a drooping eyelid (ptosis)): In myasthenia gravis, the muscles that hold your eyelid up need a steady signal from nerve to muscle through acetylcholine receptors (the docking stations where the nerve message lands on the muscle). Antibodies block those receptors, so after a few seconds of looking up, fewer and fewer receptors are free to catch the signal, and the eyelid droops more and more. Normal droopy eyelids stay the same all day — myasthenia gravis eyelids get worse with use and better with rest. This is the signature clue.
- Double vision that comes and goes, worse when tired or reading: The six tiny muscles that aim each eye need to fire hundreds of times a minute to keep both eyes pointed the same way. When antibodies block acetylcholine receptors on those muscles, the signals weaken with use, and the eyes drift apart. You see two images instead of one. This fluctuating double vision is classic for myasthenia gravis and almost never happens in stroke or brain tumor (which cause steady, non-fatigable double vision).
- Weak smile, nasal voice, or trouble swallowing: These are bulbar muscles — the muscles in your face, throat, and tongue controlled by nerves from the brainstem (the bottom part of the brain where it meets the spinal cord). When antibodies block acetylcholine receptors here, your smile flattens, air leaks through your nose when you talk, and food or liquid can go down the wrong pipe. Bulbar weakness means the disease is spreading beyond the eyes and raises the risk of choking or breathing trouble.
- Arm or leg weakness that gets worse during the day or after repeated use: The big muscles close to the body — shoulders and hips (called proximal muscles) — tire out in myasthenia gravis because each contraction uses up more of the shrinking pool of free acetylcholine receptors. After ten arm raises, the signal is weaker than after the first. Rest lets acetylcholine build back up, so strength improves after a nap or overnight. This fatigue-with-use pattern is almost unique to myasthenia gravis.
- Shallow breathing, trouble taking a deep breath, or cannot hold breath for 20 seconds: This is myasthenic crisis — the diaphragm (the big breathing muscle under your lungs) and the intercostal muscles (the rib muscles) cannot get enough signal through the blocked acetylcholine receptors to pull air in. Carbon dioxide builds up, oxygen drops, and the person can stop breathing. This is life-threatening and needs ICU care and a ventilator right away.
- Weakness improves within 30 to 60 minutes after taking pyridostigmine or after an edrophonium (Tensilon) test: Pyridostigmine and edrophonium block the enzyme (acetylcholinesterase) that breaks down acetylcholine, so more neurotransmitter stays in the synapse and gets more chances to land on the few open receptors. If strength comes back, it proves the problem is at the acetylcholine receptor, not in the muscle itself or the nerve. This is a bedside confirm for myasthenia gravis.

Diagnostics · every test answers a question

- Anti-acetylcholine receptor (anti-AChR) antibodies → Is the immune system attacking the docking stations (acetylcholine receptors) where nerve signals land on muscle?
- Anti-muscle-specific kinase (anti-MuSK) antibodies → In someone with classic myasthenia gravis symptoms but negative anti-AChR antibodies, is a different antibody attacking a different part of the neuromuscular junction?
- Single-fiber electromyography (EMG) → Is the nerve-to-muscle signal unstable and jittery, the way it would be if some receptors are blocked?
- Repetitive nerve stimulation (RNS) test → Does the muscle response get weaker when the nerve is zapped over and over, proving that the acetylcholine receptors are running out of capacity?
- Chest CT scan (with and without contrast) → Is there a thymoma (a tumor of the thymus gland) or thymic hyperplasia (an enlarged thymus), which can drive the autoimmune attack in myasthenia gravis?
- Pulmonary function tests (especially forced vital capacity, FVC, and negative inspiratory force, NIF) → How strong are the breathing muscles, and is the person at risk of respiratory failure?

Treatment logic

- Pyridostigmine (acetylcholinesterase inhibitor), 30–60 mg by mouth every 4–6 hours → Blocks acetylcholinesterase (the enzyme that chops up acetylcholine in the synapse), so each molecule of acetylcholine stays around longer and gets more chances to bind to the few open receptors. This buys back some strength by stretching the signal. Weakness improves within 30 minutes to 2 hours.
- Corticosteroids (prednisone 0.75–1 mg/kg/day, then taper) to suppress the immune system → Quiets the overactive immune system so it makes fewer antibodies against acetylcholine receptors and stops destroying them. Over weeks to months, more receptors survive and muscle strength improves. This treats the root cause.
- Steroid-sparing immunosuppressants (azathioprine 2–3 mg/kg/day, mycophenolate 1000 mg twice daily, or rituximab for refractory cases) → Suppresses the immune cells (B cells and T cells) that make the anti-AChR or anti-MuSK antibodies, reducing antibody production and receptor destruction. Allows you to lower or stop steroids and avoid their side effects. Takes 6 to 12 months to reach full effect.

- Thymectomy (surgical removal of the thymus gland) → The thymus (a small gland behind the breastbone) is where the immune system is trained; in myasthenia gravis, it often harbors the B cells making anti-AChR antibodies or contains a thymoma tumor that drives the autoimmune attack. Removing it reduces the antibody source and improves long-term remission rates, especially in AChR-positive patients under 60 years old.
- Intravenous immunoglobulin (IVIG, 2 g/kg over 2–5 days) during myasthenic crisis or severe flare-up (exacerbation) → Floods the bloodstream with pooled antibodies from thousands of donors; these neutral antibodies bind to and block the receptors on immune cells (Fc receptors) that would otherwise help destroy acetylcholine receptors, and they dilute and clear the harmful anti-AChR antibodies. Strength improves within 3 to 7 days.
- Plasma exchange (plasmapheresis, 5 exchanges over 7–10 days) during myasthenic crisis → Physically removes the patient's plasma (the liquid part of blood, where antibodies float) and replaces it with donor plasma or albumin. This strips out the anti-AChR or anti-MuSK antibodies, so more receptors are free to work. Strength improves within 2 to 3 days.
- Avoid drugs that worsen myasthenia gravis: aminoglycosides (gentamicin, tobramycin), fluoroquinolones (ciprofloxacin, levofloxacin), macrolides (azithromycin, erythromycin), beta-blockers (propranolol, metoprolol), magnesium sulfate, neuromuscular blockers (succinylcholine, vecuronium), and statins in high doses → These drugs either block acetylcholine release from the nerve, block the acetylcholine receptor directly, or interfere with the muscle's ability to contract. Avoiding them prevents a second hit that could tip a stable patient into crisis.

Medications

Pyridostigmine · Acetylcholinesterase inhibitor

Pyridostigmine blocks the enzyme (acetylcholinesterase) that normally breaks down acetylcholine (the chemical messenger that tells muscles to squeeze). When you block that enzyme, acetylcholine sticks around longer at the neuromuscular junction (the tiny gap where nerve meets muscle). More acetylcholine means a stronger signal gets through, even though the antibodies are blocking many receptors. It is like turning up the volume to make up for a weak connection.

1. Your motor nerve releases acetylcholine into the gap between nerve and muscle.
2. Normally, acetylcholinesterase chews up acetylcholine within milliseconds so the signal stops.
3. Pyridostigmine jams that cleanup enzyme.
4. Acetylcholine builds up and keeps hitting the few receptors that are still open.
5. The muscle gets a stronger, longer signal and squeezes better.

SAFETY WATCH

Too much can cause cholinergic crisis: sweating, drooling, stomach cramps, diarrhea, slow heart rate, tiny pupils, and muscle twitching. · Tell your doctor right away if weakness gets worse after a dose—this might mean too much rather than too little medicine. · Avoid taking more than prescribed; more is not always better and can backfire.

Prednisone (or other corticosteroids) · Corticosteroid immunosuppressant

Prednisone turns down the whole immune system by blocking the signals inside white blood cells that tell them to make antibodies and attack. It quiets B cells (the cells that make the bad antibodies against acetylcholine receptors) and calms inflammation. Over weeks to months, fewer new antibodies are made and symptoms ease.

1. Prednisone enters immune cells and binds to receptors inside them.
2. It shuts off genes that make inflammatory chemicals and antibodies.
3. B cells slow down antibody production, including the anti-AChR antibodies.
4. Over weeks, the level of attacking antibodies drops.
5. Fewer antibodies means more acetylcholine receptors survive, so muscles work better.

SAFETY WATCH

Watch for high blood sugar, weight gain, mood swings, trouble sleeping, and increased appetite. · Long-term use can weaken bones (osteoporosis), raise blood pressure, cause cataracts, and thin the skin. · Never stop suddenly after weeks of use—your body needs to be tapered off slowly to avoid adrenal crisis. · Tell your doctor about any signs of infection (fever, cough, sores) because steroids hide warning signs and make infections spread faster. · Get regular bone-density scans and take calcium and vitamin D if you are on prednisone long-term.

Azathioprine · Purine-analog immunosuppressant

Azathioprine is a fake building block that slips into the DNA of fast-dividing immune cells. When B cells and T cells try to copy themselves, the fake piece jams the copying machine. Fewer new immune cells means fewer antibodies being made over time. It lets doctors lower the steroid dose and keep the immune attack quiet.

1. Azathioprine is broken down in the liver into 6-mercaptopurine.
2. That chemical gets mistaken for a real DNA building block (a purine).
3. When immune cells try to divide, the fake block gets stuck in their DNA.
4. The cell cannot finish copying and dies or stops dividing.
5. Over weeks to months, the pool of antibody-making cells shrinks and symptoms improve.

SAFETY WATCH

Get regular blood counts; azathioprine can drop white cells, red cells, and platelets. · Watch for signs of infection (fever, sore throat, unusual bruising). · Tell your doctor about nausea or belly pain—rarely, it can inflame the liver or pancreas. · Azathioprine raises the long-term risk of certain skin cancers; use sunscreen and get skin checks. · Some people have a gene variant (low TPMT enzyme) that makes the drug build up dangerously; your doctor may test for this before starting.

Mycophenolate mofetil · Inosine monophosphate dehydrogenase (IMPDH) inhibitor

Mycophenolate blocks an enzyme (IMPDH) that immune cells need to make guanosine, one of the building blocks of DNA. Lymphocytes rely heavily on this pathway to multiply, so blocking it starves them of raw material. B cells slow down and make fewer antibodies, including the ones attacking acetylcholine receptors.

1. Mycophenolate enters immune cells and jams the IMPDH enzyme.
2. Without that enzyme, cells cannot make enough guanosine for new DNA.
3. B cells and T cells cannot divide as fast.
4. The number of antibody-producing cells drops over weeks to months.
5. Fewer anti-AChR antibodies means more receptors survive and muscles work better.

SAFETY WATCH

Watch for diarrhea, nausea, and stomach cramps—very common, especially at first. · Get regular blood counts; it can lower white cells and raise infection risk. · Tell your doctor about any fever, cough, or signs of infection. · Do NOT use during pregnancy—it causes serious birth defects. Women must use reliable birth control. · Avoid live vaccines while on this drug.

Rituximab · Monoclonal antibody (anti-CD20)

Rituximab is a lab-made antibody that locks onto CD20, a marker found on the surface of B cells (the cells that make antibodies). Once rituximab tags a B cell, the immune system sweeps it away. Wiping out B cells stops the production of new anti-AChR or anti-MuSK antibodies, and symptoms improve over weeks to months as the old antibodies fade.

1. Rituximab is given by IV infusion and travels through the blood.
2. It sticks to CD20 on the surface of B cells.
3. The tagged B cells are killed by the immune system's cleanup crew or by direct cell rupture.

4. Within days to weeks, B cells are nearly gone from the blood.
5. No new antibodies are made; old antibodies slowly break down over months.
6. Muscle strength gradually returns as receptor levels recover.

SAFETY WATCH

Infusion reactions (fever, chills, itching, throat tightness) can happen during or right after the infusion; you will be watched closely and may get pre-meds. · Rituximab wipes out B cells for 6 to 12 months, raising infection risk—tell your doctor about any fever or unusual symptoms. · Rarely, it can reactivate hepatitis B; your doctor will test for this before starting. · Very rarely, it can cause progressive multifocal leukoencephalopathy (PML), a serious brain infection—watch for new confusion, weakness, or vision changes. · Avoid live vaccines while B cells are low.

Eculizumab · Monoclonal antibody (complement C5 inhibitor)

Eculizumab blocks C5, a protein in the complement cascade (a chain reaction in the immune system that punches holes in cells). In MG, antibodies tag acetylcholine receptors, and complement finishes the job by tearing the receptors apart. Eculizumab jams that final step, so the receptors survive even though antibodies are still there. Muscles work better because more receptors stay intact.

1. Antibodies bind to acetylcholine receptors and call in complement proteins.
2. Complement proteins normally form a membrane attack complex (MAC) that punches a hole in the receptor, killing it.
3. Eculizumab binds to C5 and stops it from being cut into C5a and C5b.
4. Without C5b, the MAC cannot form.
5. Receptors tagged by antibodies survive instead of being destroyed.
6. More working receptors means stronger muscle signals and less weakness.

SAFETY WATCH

Eculizumab makes you very vulnerable to *Neisseria meningitidis* (meningococcal bacteria)—you **MUST** get vaccinated at least 2 weeks before starting (or get antibiotics if urgent). · Watch for sudden fever, severe headache, stiff neck, rash, confusion, or sensitivity to light—these are signs of meningitis. Go to the ER immediately. · Carry a safety card at all times explaining you are on eculizumab. · Tell your doctor about any infection symptoms—risk is also higher for other encapsulated bacteria like *Streptococcus pneumoniae* and *Haemophilus influenzae*. · Eculizumab is very expensive and given by infusion every 2 weeks after a loading phase.

Intravenous immunoglobulin (IVIG) · Pooled human antibodies

IVIG is a mix of healthy antibodies from thousands of blood donors. When you flood the bloodstream with normal antibodies, they crowd out and block the bad antibodies from binding to acetylcholine receptors. IVIG also turns down the immune system by several other paths, including speeding up the breakdown of harmful antibodies. It works fast—within days—but the effect wears off in weeks.

1. IVIG is given by IV infusion over several hours, usually for 2 to 5 days in a row.
2. Normal antibodies flood the blood and compete with anti-AChR antibodies for receptors and cleanup pathways.
3. IVIG binds to Fc receptors on immune cells, sending a "calm down" signal.
4. The body speeds up the breakdown of all circulating antibodies, including the harmful ones.
5. Within days, muscle strength improves because fewer bad antibodies are attacking receptors.
6. The effect lasts 3 to 6 weeks, then symptoms creep back unless you repeat the infusion or add long-term treatment.

SAFETY WATCH

Headache, fever, chills, and body aches are common during or after infusion—slow the rate or take acetaminophen. · Rarely, IVIG can cause blood clots (stroke, heart attack, deep vein clots), especially in older adults or those with heart disease or thick blood. · Kidney damage can happen, especially with certain formulations; stay well hydrated. · Very rarely, it can cause aseptic meningitis (sterile brain inflammation): severe headache, stiff neck, nausea, light sensitivity—call your doctor. · Allergic reactions (rash, itching, wheezing) can occur; tell the nurse right away. · People with IgA deficiency can have severe reactions; you may be tested first.

Plasma exchange (plasmapheresis) · Procedure (not a drug)

Plasma exchange filters your blood outside your body, removing the liquid part (plasma) that holds the harmful antibodies. The machine replaces the removed plasma with donor plasma or albumin (a safe protein solution). It physically yanks out the anti-AChR or anti-MuSK antibodies, so muscles work better within days. The effect is fast but temporary—your body starts making new antibodies right away.

1. A large IV line (often in the neck or groin) connects you to the plasma exchange machine.
2. Blood is pumped out, and the machine spins it to separate red cells from plasma.
3. The plasma (which contains antibodies) is thrown away.
4. Your red cells are mixed with replacement fluid (donor plasma or albumin) and pumped back in.

5. After 5 to 7 sessions over 10 to 14 days, the level of bad antibodies drops sharply.
6. Muscle strength improves within days because receptors are no longer under heavy attack.

SAFETY WATCH

Requires a large IV line, which carries risk of infection, bleeding, or blood clots in the vein.

- Removing plasma takes away clotting factors and antibodies you need, so you are at higher risk for bleeding and infection during treatment.
- Low calcium and low blood pressure can happen during the session—tell the nurse if you feel dizzy, tingly, or nauseated.
- Rarely, allergic reactions to donor plasma or citrate (the anticoagulant) occur.
- Not all hospitals offer plasma exchange; it is more complex and expensive than IVIG.

Red flags

- Trouble breathing, very short of breath, or can't take a deep breath (may mean the diaphragm is failing—myasthenic crisis—and you need emergency care right away)
- Choking often, coughing every time you swallow, or food or liquid going down the wrong pipe (aspiration risk—food can get into the lungs and cause pneumonia)
- Sudden big jump in weakness after starting a new medicine, after surgery, or during an infection (these can trigger a dangerous flare called a crisis)

Nursing priorities

1. Assess respiratory effort every two to four hours: measure vital capacity (how much air the lungs can hold), watch for shallow breathing, use of neck muscles to breathe, and inability to cough or clear secretions — Myasthenic crisis causes respiratory muscle failure which is the number one cause of death; early detection lets us get the patient on a breathing machine before full respiratory arrest happens
2. Keep suction equipment and bag-valve mask at bedside; ensure rapid ICU transfer plan is ready — Respiratory failure can happen fast in myasthenic crisis; having emergency airway equipment immediately available saves minutes that prevent brain damage from low oxygen
3. Monitor swallowing carefully before every meal; keep patient upright at ninety degrees during and thirty minutes after eating; have patient take small bites and sips — Bulbar muscle weakness (throat and mouth weakness) causes aspiration (food or liquid going into lungs instead of stomach) which leads to aspiration pneumonia and worsens respiratory status

4. Give pyridostigmine (acetylcholinesterase inhibitor that increases acetylcholine availability) on exact schedule; never hold or delay doses without provider order — Pyridostigmine levels must stay steady to keep the neuromuscular junction (nerve-to-muscle connection) working; missing doses causes sudden severe weakness and can trigger myasthenic crisis
5. Check all ordered medications against the avoid list before giving: stop and call provider if aminoglycosides, fluoroquinolones, beta-blockers, or neuromuscular blockers are ordered — These drugs block acetylcholine receptors or interfere with neuromuscular transmission (nerve-to-muscle signals); giving them causes rapid severe weakness and myasthenic crisis even if the patient was stable before
6. Protect eyes if patient cannot close eyelids fully: use artificial tears every two hours while awake, tape eyelids shut gently at night, assess for redness or pain — A drooping eyelid (Ptosis) and weak eyelid closure cause corneal abrasions (scratches on eye surface) and dry eye which lead to infection and vision loss
7. Schedule activities and medications when muscle strength is best, usually thirty to sixty minutes after pyridostigmine dose; allow frequent rest breaks between tasks — Muscle strength fluctuates during the day in myasthenia gravis; timing care during peak strength prevents falls, aspiration, and exhaustion from muscle overuse
8. Teach patient and family to recognize crisis warning signs: trouble breathing, drooling, choking, weak cough, cannot lift head off pillow; give emergency contact numbers — Myasthenic crisis develops over hours to days; family who can spot early signs and get help fast reduce ICU admissions and prevent respiratory arrest at home

Sources

- Myasthenia Gravis Foundation of America (MGFA) International Consensus Guidance 2020
- American Academy of Neurology (AAN) practice parameter on myasthenia gravis
- Cochrane systematic review on immunosuppression in myasthenia gravis
- UpToDate clinical summary on myasthenia gravis (peer-reviewed, guideline-referenced)

Last reviewed: 2026-07-07