

Cardiomyopathy

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THE STORY IN ONE SENTENCE

Cardiomyopathy means the heart muscle is sick—it might squeeze too weakly, get too thick, turn stiff, or fill with scar—and each type breaks the pump in a different way.

“Cardiomyopathy is disease of the heart muscle itself. The type of disease decides how we treat it.”

Normal anatomy — the body's job

The heart is a hollow muscle about the size of your fist. It has four rooms: two on top (atria) that collect blood, and two on the bottom (ventricles) that pump it out. The left ventricle is the strongest—it pumps oxygen-rich blood to your whole body. The right ventricle pumps blood to your lungs to pick up oxygen. The muscle walls squeeze (contract) and then relax in a rhythm, over and over, about 60 to 100 times every minute.

BODY'S JOB

The heart's job is to pump blood everywhere your body needs it. When the muscle squeezes, blood shoots out to your organs, brain, and limbs. When the muscle relaxes, blood flows back in to refill the chambers. Healthy heart muscle is strong, stretchy, and smooth—it contracts with force and relaxes completely so the pump never stops.

1. Blood that is low in oxygen returns from the body into the right atrium.
2. The right atrium squeezes and pushes blood into the right ventricle.
3. The right ventricle squeezes and pumps blood to the lungs, where it picks up oxygen.
4. Oxygen-rich blood flows back from the lungs into the left atrium.
5. The left atrium squeezes and fills the left ventricle.
6. The left ventricle squeezes hard and pumps that oxygen-rich blood out through the aorta to the whole body.
7. The cycle repeats every second, all day, every day.

What breaks

In cardiomyopathy, the heart muscle itself gets damaged or changes shape. It might stretch out and become weak, grow too thick and stiff, turn rigid from scar tissue or deposits, or get replaced by fat and scar. When the muscle breaks, the pump fails.

CLINICAL TERM

Cardiomyopathy is intrinsic disease of the myocardium (the heart muscle). The muscle can dilate (stretch and thin), hypertrophy (thicken abnormally), become restrictive (stiff and unable to relax), undergo fibrofatty replacement (ARVC), experience stress-induced ballooning (takotsubo), or become infiltrated by abnormal proteins or substances (amyloid, sarcoid, iron, glycogen). The result is impaired systolic function (poor squeeze), diastolic dysfunction (poor relaxation and filling), or both, leading to heart failure, arrhythmias, thromboembolism, and risk of sudden cardiac death.

How the body compensates

At first, the body tries to make up for the weak or stiff heart. It speeds up the heart rate, squeezes blood vessels tighter, and holds onto salt and water to keep blood pressure up. These tricks work for a while, so the patient may feel okay. But over time, these same responses make the heart work even harder and cause congestion—fluid backs up into the lungs and legs. Eventually, the heart cannot keep up and heart failure symptoms appear. The dangerous part is that vital signs can look normal even while the heart is silently failing.

1. {'step': 'The nervous system releases adrenaline and turns on the sympathetic (fight-or-flight) response.', 'why': 'This makes the heart beat faster and squeeze harder to try to pump more blood. Short-term, it helps. Long-term, it wears the heart out and makes arrhythmias more likely.'}
2. {'step': 'The kidneys release renin, which triggers a chain (the RAAS system) that makes the hormone aldosterone.', 'why': 'Aldosterone tells the kidneys to hold onto salt and water, raising blood volume and blood pressure. This boosts the amount of blood returning to the heart. But it also causes fluid to leak into the lungs and tissues, leading to swelling and shortness of breath.'}
3. {'step': 'Blood vessels tighten (vasoconstriction).', 'why': 'Narrowing the pipes raises blood pressure to keep blood flowing to the brain and vital organs. But it also makes the heart push harder against that resistance, which tires it out faster.'}
4. {'step': 'The heart muscle stretches to hold more blood (dilation) or thickens to generate more force (hypertrophy).', 'why': 'Stretching helps the heart hold more blood and pump more with each beat—up to a point. But overstretched muscle is weak. Thickening helps generate force, but thick muscle is stiff and needs more oxygen, which it might not get.'}

5. {'step': 'Over time, these compensation tricks fail. The heart dilates too much, fluid backs up, and organs do not get enough blood.', 'why': 'The tired, overstretched, or stiff heart cannot keep up. Fluid congests the lungs (causing shortness of breath) and the body (causing leg swelling). Blood pressure may drop, kidneys may fail, and dangerous arrhythmias become common.'}
6. {'step': 'Watch the trend, not just one set of vital signs. A patient with normal blood pressure but rising heart rate, worsening shortness of breath, and new leg swelling is decompensating—heading toward the crash point.', 'why': 'The body can mask decline for days to weeks. By the time blood pressure drops or the patient faints, the window to prevent serious harm may have closed. Early signs—fatigue, subtle swelling, exercise intolerance—are the red flags.'}

Domino effect

1. The heart muscle is damaged or changed—stretched, thickened, stiffened, or replaced by scar and fat. — This is the upstream break. Genes, toxins, viruses, starved blood flow (ischemia), infiltration, or stress injure the muscle. Everything that follows flows from this one broken thing.
2. The damaged muscle cannot pump blood forward effectively (systolic failure) or cannot relax and fill properly (diastolic failure). — In dilated cardiomyopathy, the weak, stretched muscle squeezes poorly. In hypertrophic and restrictive types, the thick or stiff muscle cannot relax, so the heart cannot fill. In ARVC, the scarred right ventricle is both weak and electrically unstable.
3. Blood backs up behind the failing heart, causing congestion. — If the left side fails, blood backs up into the lungs—fluid leaks into the air sacs, causing shortness of breath, cough, and crackles on exam (pulmonary swelling (edema)). If the right side fails, blood backs up into the body—the liver swells, the belly fills with fluid (ascites), and the legs and ankles swell (peripheral swelling).
4. Not enough blood flows forward to the body and brain, causing fatigue, dizziness, fainting, and organ damage. — Low cardiac output means your muscles do not get enough oxygen (you feel weak and tired), your brain gets less blood (you feel lightheaded or faint), and your kidneys and liver start to fail from poor blood flow (perfusion).
5. The sick heart muscle and scarring disrupt electrical signals, leading to arrhythmias. — Scar tissue and stretched or thickened muscle interfere with the normal electrical pathway. You see atrial fibrillation (an irregular, quivering heartbeat) (fast, chaotic rhythm in the top chambers), ventricular a fast heart rate (tachycardia) (fast, dangerous rhythm in the bottom chambers), or heart block. Arrhythmias reduce pumping efficiency and can cause sudden cardiac arrest.

6. Blood pools in the dilated, weakly squeezing chambers, forming clots. — Slow-moving or stagnant blood clots easily. Clots can break off and travel—to the lungs (pulmonary a traveling clot lodging in a vessel (embolism)), brain (stroke), or limbs (arterial a traveling clot lodging in a vessel).
7. In hypertrophic cardiomyopathy, the thick septum can block blood flow out of the heart (left ventricular outflow tract obstruction). — The bulky muscle and abnormal valve motion create a narrow exit. Blood has to squeeze through a tight space, causing a harsh murmur, chest pain, fainting with exercise, and sudden death risk.
8. Over time, the heart remodels—it stretches more, scars more, and becomes even weaker. — The ongoing stress, inflammation, and cell death create a vicious cycle. The heart tries to compensate, but those very responses (adrenaline, stretching, thickening) damage the muscle further. Without treatment, the patient spirals toward end-stage heart failure, needing advanced therapies like a ventricular assist device or heart transplant.

Symptoms · what the patient feels, and why

- Shortness of breath, especially when lying flat or during activity: The heart muscle is too weak or too stiff to pump blood forward well, so blood backs up into the lungs. This extra fluid in the lungs makes it hard to breathe.
- Swelling in the legs, ankles, or belly: When the heart cannot pump strongly enough, blood pools in the veins. Fluid leaks out of the blood vessels into the tissues, causing puffiness and swelling (edema).
- Extreme tiredness and weakness: The weakened heart cannot deliver enough oxygen-rich blood to the muscles and organs, so they run low on fuel. This makes even small tasks feel exhausting.
- Chest pain or pressure: In some types of cardiomyopathy, the thick or stiff heart muscle needs more oxygen than the blood can deliver, causing the heart muscle to hurt (similar to angina).
- Fast, pounding, or fluttering heartbeat (palpitations): The damaged heart muscle can create abnormal electrical signals, causing the heart to beat too fast, skip beats, or quiver instead of pumping smoothly.
- Fainting or feeling lightheaded: Dangerous irregular heartbeats (arrhythmias) or a sudden drop in blood pressure can briefly cut oxygen to the brain, making a person feel dizzy or pass out.
- Coughing, especially at night or when lying down: Fluid backed up in the lungs irritates the airways, triggering a cough. Lying flat makes more fluid shift into the lungs, so the cough often gets worse at night.

- Family history of sudden death or heart failure at a young age: Some types of cardiomyopathy are inherited (passed down in genes). If close relatives had sudden cardiac death or severe heart problems before age 50, the same gene change may run in the family.

Focused exam

- Displaced point of maximal impulse (PMI) — the heartbeat you feel on the chest is pushed outward and down: In dilated cardiomyopathy, the heart chamber gets bigger, so the spot where you feel the strongest beat moves. This tells you the heart muscle is stretched and weak.
- Third heart sound (S3 gallop) — an extra sound like 'lub-DUB-dum' when the doctor listens: This sound means the heart is struggling to fill with blood and is backing up. It is the sound of cardiomyopathy failing to pump well.
- Crackles in the lungs when you breathe in — like Rice Krispies in the chest: When the heart pump is weak, fluid backs up into the lungs. Cardiomyopathy causes this backup, and it makes breathing harder.
- Swollen legs and belly (edema and fluid buildup in the belly (ascites)) — puffiness that leaves a dent when you press it: Weak heart muscle cannot push blood forward well, so fluid pools in the body. This is the cardiomyopathy telling you the pump is falling behind.
- Irregular heartbeat on exam or monitor — skipped beats or runs of fast beats: A stretched, weak heart muscle from cardiomyopathy becomes irritable and triggers extra beats. This is a warning sign of sudden danger.
- Low blood pressure (hypotension) and cold, clammy skin: Cardiomyopathy means the heart is not pumping enough blood to keep pressure up. The body pulls blood away from the skin to protect the brain.
- Jugular venous pressure (JVP) is elevated — neck veins stick out even when sitting up: The weak heart cannot push blood backward out of the neck veins, so they back up. This is cardiomyopathy causing backup all the way to the head.

Diagnostics · every test answers a question

- Transthoracic echocardiogram (TTE) — ultrasound movie of the beating heart → Is the heart chamber too big, too thick, or too stiff? How well is it squeezing and filling?
- B-type natriuretic peptide (BNP) or NT-proBNP — blood test for heart stress hormones → Is the heart muscle under stress and stretching?
- 12-lead electrocardiogram (ECG) — tracing of the heart's electricity → Are there signs of thick muscle, scarring, or dangerous irregular beats?

- Cardiac MRI with late gadolinium enhancement (LGE) — detailed picture of the heart muscle with a dye that lights up scars → Is there scar or abnormal tissue in the heart muscle, and what is the pattern?
- Troponin I or T — blood test for heart muscle injury → Is the heart muscle being damaged right now, or is this an old problem?
- Genetic testing — blood test looking for mutations in heart muscle genes (like MYH7, MYBPC3, TTN, LMNA, desmoplakin) → Is there a gene change that explains why the heart muscle is sick, and do family members carry it?
- Serum protein electrophoresis (SPEP) and free light chains — blood test for abnormal proteins → Is there abnormal protein building up in the blood that could be clogging the heart?
- Serum iron studies (ferritin, transferrin saturation) — blood test for iron overload → Is there too much iron in the body that could be poisoning the heart muscle?

Treatment logic

- Identify the TYPE first: dilated vs. hypertrophic vs. restrictive vs. ARVC vs. takotsubo vs. infiltrative → You cannot pick the right medicine until you know which broken thing you are fixing. The echo and ECG pattern tell you which type.
- For dilated cardiomyopathy with reduced ejection fraction (HFrEF): start ARNI (sacubitril/valsartan), beta-blocker (carvedilol, metoprolol succinate, or bisoprolol), MRA (spironolactone or eplerenone), and SGLT2 inhibitor (dapagliflozin or empagliflozin) → These four drugs together reduce the stress on the weak squeezing heart, block harmful hormones (like aldosterone and angiotensin), help the kidneys dump extra fluid, and help the heart muscle use sugar and fat better. Together they cut the risk of dying or ending up in the hospital by about 50 percent.
- For hypertrophic cardiomyopathy: start a beta-blocker (metoprolol or atenolol) or a calcium-channel blocker (verapamil or diltiazem); consider mavacamten if symptoms persist → Beta-blockers and calcium blockers slow the heart rate and relax the thick muscle so the heart has more time to fill with blood. Mavacamten is a new drug that loosens the grip of the muscle fibers so blood flows better out of the heart. It can reduce obstruction and improve symptoms.
- For infiltrative or restrictive cardiomyopathy: treat the underlying cause — tafamidis or diflunisal for ATTR cardiac amyloidosis, chemotherapy and stem-cell transplant for AL amyloidosis, corticosteroids or methotrexate for cardiac sarcoidosis, phlebotomy or chelation for hemochromatosis → If you stop amyloid protein from building up, shrink the inflammatory granulomas in sarcoid, or remove poison iron, the stiff heart stops getting worse. Tafamidis cuts the risk of death and hospitalization in ATTR amyloid by about 30 percent. The domino halts upstream.

- For arrhythmogenic right ventricular cardiomyopathy (ARVC): start a beta-blocker, enforce strict exercise restriction (no competitive or intense sports), and place an implantable cardioverter-defibrillator (ICD) if high sudden-death risk → Beta-blockers calm the irritable right-side muscle and reduce dangerous irregular beats. Exercise makes ARVC worse, so stopping high-intensity activity slows the scarring. The ICD catches the fatal irregular beat (ventricular fibrillation) and shocks the heart back before it kills you.
- For takotsubo (stress) cardiomyopathy: supportive care with beta-blockers and ACE inhibitors or ARBs; avoid triggers → Takotsubo usually recovers on its own in days to weeks. Beta-blockers protect the heart from another surge of stress hormones. ACE inhibitors help the heart muscle heal.
- For all types with heart failure symptoms: loop diuretic (furosemide or torsemide) to remove extra fluid → Diuretics make you pee out the backed-up fluid in your lungs and legs. This helps you breathe easier and reduces swelling.
- For all types: genetic testing and family screening, then genetic counseling → Knowing the mutation lets relatives know if they carry it before their heart breaks. Early screening with echo and ECG every few years can catch disease early, when treatment works best. This saves lives.

Medications

Sacubitril-valsartan (an ARNI) · Angiotensin receptor-neprilysin inhibitor

This drug does two jobs at once. First, it blocks angiotensin receptors (stopping a hormone that squeezes blood vessels tight and makes the heart work harder). Second, it stops neprilysin, an enzyme that normally breaks down helpful peptides—so now those helpful peptides (like BNP) can stay around longer and open blood vessels, help the kidneys get rid of salt and water, and ease the load on the heart. Together, these two actions lower blood pressure and reduce the strain on a weakened, stretched heart muscle.

1. Valsartan blocks angiotensin II type-1 receptors so blood vessels relax instead of squeezing tight.
2. Sacubitril stops neprilysin from breaking down natriuretic peptides (BNP, ANP) and bradykinin.
3. More natriuretic peptides mean the kidneys release more sodium and water (less fluid overload) and blood vessels stay wider.
4. The heart pumps against less resistance and the stretched muscle gets a break.

SAFETY WATCH

Can cause low blood pressure (dizziness, fainting)—check blood pressure regularly. · Can raise potassium too high—monitor blood tests, especially if you also take a potassium-sparing diuretic or have kidney problems. · Never combine with an ACE inhibitor or give within 36 hours of the last ACE-inhibitor dose—doing so raises the risk of angioedema (dangerous swelling of the tongue, throat, or face). · Can harm a developing baby—do not use during pregnancy.

Metoprolol or carvedilol or bisoprolol · Beta-blocker

These drugs block beta receptors on the heart, which are docking spots for adrenaline (the 'fight-or-flight' hormone). Normally, adrenaline makes the heart beat faster and squeeze harder. In a failing or thickened heart, that extra stress wears the muscle out over time. By blocking adrenaline, beta-blockers slow the heart rate, lower blood pressure, and give the heart more time to fill and rest between beats—protecting it from constant overdrive and helping it pump more efficiently in the long run.

1. The drug sits on beta receptors and blocks adrenaline and noradrenaline from binding.
2. Heart rate slows down (fewer beats per minute).
3. Each contraction becomes less forceful (less oxygen demand).
4. The heart has more time to fill with blood between beats.
5. Over weeks to months, the heart muscle remodels—it becomes less stretched and works more efficiently.

SAFETY WATCH

Can cause tiredness, dizziness, or cold hands and feet (less adrenaline means less 'get-up-and-go'). · May worsen asthma or COPD by narrowing airways (especially non-selective beta-blockers)—use cautiously or pick a heart-selective one (bisoprolol, metoprolol). · Can mask signs of low blood sugar in people with diabetes. · Start at a low dose and increase slowly—sudden high doses can worsen heart failure symptoms at first. · Do NOT stop suddenly—rebound high heart rate and blood pressure can happen.

Spirolactone or eplerenone · Mineralocorticoid receptor antagonist (MRA)

These drugs block aldosterone, a hormone that tells the kidneys to hold onto salt and water and push out potassium. In heart failure, the body makes too much aldosterone, which causes fluid to pile up (swelling, lung congestion) and scars the heart muscle over time. By blocking aldosterone receptors in the kidneys and heart, MRAs help the body get rid of extra salt and

water (reducing swelling and lung fluid) and prevent harmful scarring and stiffening of the heart.

1. The drug blocks mineralocorticoid receptors so aldosterone cannot dock.
2. The kidneys release more sodium and water into the urine (less fluid overload).
3. The kidneys hold onto potassium instead of dumping it out.
4. Less aldosterone activity means less fibrosis (scarring) forming in the heart muscle and blood vessels.
5. Over time, the heart becomes less stiff and the risk of dangerous heart rhythms drops.

SAFETY WATCH

Can raise potassium too high (hyperkalemia)—very dangerous if severe (can stop the heart). Check blood tests regularly, especially if you also take an ACE inhibitor, ARB, or ARNI. · Spironolactone can cause breast tenderness or enlargement in men (gynecomastia) because it also blocks some hormone receptors; eplerenone is more selective and causes this less often. · Can worsen kidney function in people who already have kidney disease—monitor creatinine and potassium closely. · Not safe during pregnancy.

Dapagliflozin, empagliflozin, or sotagliflozin · Sodium-glucose co-transporter 2 inhibitor (SGLT2i)

These drugs block a transporter in the kidney that normally pulls sugar (glucose) and sodium back into the blood from the urine. By blocking it, the kidneys dump more sugar and sodium into the urine, which pulls water along with it. This gentle diuretic effect reduces fluid overload and blood pressure. Beyond that, SGLT2 inhibitors shift the heart's fuel use (the heart burns more ketones and less glucose, which is more efficient), reduce inflammation, and protect the kidneys—all of which help a failing heart work better and slow the progression of cardiomyopathy.

1. The drug blocks SGLT2 transporters in the kidney so glucose and sodium stay in the urine instead of being reabsorbed.
2. More glucose, sodium, and water leave the body (gentle diuresis).
3. Blood volume drops slightly, lowering blood pressure and reducing the heart's workload.
4. The heart shifts to burning ketones (a cleaner, more efficient fuel) instead of relying only on glucose.
5. Inflammation and oxidative stress in the heart and blood vessels decrease.
6. Kidney function is protected, and the risk of hospitalization for heart failure drops.

SAFETY WATCH

Can cause genital yeast infections (more sugar in the urine feeds yeast)—treat with antifungal cream or pills if it happens. · Can cause urinary tract infections for the same reason—drink plenty of water and watch for burning or urgency. · Rare risk of diabetic ketoacidosis (the acid crisis of missing insulin) (DKA), even in people without diabetes—stop the drug before surgery or if you become very sick. · Can cause low blood pressure or dehydration, especially in older adults or if combined with diuretics—monitor symptoms like dizziness. · Very rare risk of Fournier's gangrene (a serious infection of the genital area)—seek care immediately for pain, redness, swelling, or fever in that area. · May lower blood sugar if you also take insulin or sulfonylureas—adjust doses as needed.

Furosemide or torsemide or bumetanide · Loop diuretic

These drugs block a transporter in the kidney's loop of Henle (a part of the kidney tubule) that normally pulls sodium, chloride, and water back into the blood. By blocking it, the kidneys dump a large amount of salt and water into the urine. This quickly reduces fluid overload—less swelling in the legs, less congestion in the lungs—and makes breathing easier. Loop diuretics are used when fluid buildup is severe or when other diuretics are not strong enough.

1. The drug blocks the sodium-potassium-chloride co-transporter (NKCC2) in the kidney.
2. Sodium, chloride, potassium, and water stay in the urine instead of being pulled back into the blood.
3. A large volume of urine is produced, reducing blood volume.
4. Pressure in the heart and lungs drops, relieving congestion and shortness of breath.
5. Swelling (edema) in the legs and abdomen goes down.

SAFETY WATCH

Can cause low potassium (hypokalemia) and low magnesium—check blood tests regularly and replace if needed. · Can cause dehydration and low blood pressure if the dose is too high—watch for dizziness, dry mouth, or fainting. · Can worsen kidney function, especially if you become dehydrated—monitor creatinine. · Can raise uric acid and trigger gout attacks. · Torsemide is absorbed more reliably than furosemide, so it may work better in people with gut swelling from heart failure.

Mavacamten · Cardiac myosin inhibitor

This drug is used specifically for hypertrophic cardiomyopathy (HCM) when the heart muscle is too thick and squeezes too hard, blocking blood flow out of the heart. Mavacamten works by binding to cardiac myosin (the motor protein that makes heart muscle contract) and reducing the number of myosin heads that can grab onto actin (the track the motor pulls on). With fewer

myosin heads working, the heart's contraction becomes less forceful and the muscle relaxes better. This reduces the obstruction, improves blood flow, and relieves symptoms like chest pain and shortness of breath.

1. Mavacamten binds to the myosin head and keeps it in an 'off' position.
2. Fewer myosin heads are available to pull on actin during each heartbeat.
3. The heart's contraction becomes less forceful (reduced hypercontractility).
4. The left ventricular outflow tract (the exit path from the heart) opens wider because the thick muscle is not squeezing it shut.
5. Blood flows more easily out of the heart, and the heart fills better between beats.
6. Symptoms (shortness of breath, chest pain, fatigue) improve.

SAFETY WATCH

Can reduce heart function too much if the dose is too high—must monitor with echocardiograms every 12 weeks and adjust dose or stop if ejection fraction drops below 50%. · Drug interactions are common—strong CYP2C19 or CYP3A4 inhibitors (like fluconazole, verapamil, diltiazem) can raise mavacamten levels dangerously. Avoid grapefruit juice. · Can harm a developing baby—use effective birth control during treatment and for 4 months after stopping. · Only available through a restricted program (REMS) because of the risk of heart failure if not monitored carefully.

Disopyramide · Class Ia antiarrhythmic (also has negative inotropic effect)

This older drug is sometimes used in hypertrophic cardiomyopathy (HCM) when the heart squeezes too hard and blocks blood flow. Disopyramide blocks sodium channels in heart muscle cells, which slows down the electrical signal and reduces the force of contraction (negative inotropy). By making the heart squeeze less forcefully, it reduces the obstruction in the outflow tract and improves symptoms. It also has anticholinergic effects (blocks acetylcholine), which can speed up the heart rate slightly—balancing out the slowing effect.

1. Disopyramide blocks fast sodium channels, slowing the upstroke of the heart's electrical signal.
2. The heart muscle contracts with less force (negative inotropic effect).
3. The thick heart muscle squeezes less hard, so the outflow tract stays open.
4. Blood flows more easily out of the heart, and symptoms improve.
5. Anticholinergic effects (dry mouth, constipation, urinary retention) happen as a side effect.

SAFETY WATCH

Can worsen heart failure or cause dangerous arrhythmias if used in dilated cardiomyopathy or weak hearts—only for HCM with obstruction. · Anticholinergic effects: dry mouth, blurry vision, constipation, trouble urinating (especially in older men with prostate enlargement). · Can lower blood sugar—monitor in people with diabetes. · Drug interactions: avoid other QT-prolonging drugs (can cause torsades de pointes, a life-threatening rhythm). · Check EKG regularly to watch for QT prolongation.

Tafamidis · Transthyretin stabilizer

This drug is used for transthyretin amyloid cardiomyopathy (ATTR-CM), a type of restrictive cardiomyopathy where misfolded transthyretin protein clumps together and deposits in the heart, making it stiff. Tafamidis works by binding to transthyretin and stabilizing its normal shape, preventing it from falling apart and clumping into amyloid fibrils. By stopping new amyloid from forming, it slows the progression of the disease, reduces hospitalizations, and improves survival—though it does not remove amyloid that is already there.

1. Tafamidis binds to the four-protein complex of transthyretin (TTR) and locks it in a stable form.
2. Stable TTR does not break apart into monomers (single units).
3. Without monomers, there are no building blocks to form amyloid fibrils.
4. Less new amyloid deposits in the heart, nerves, and other tissues.
5. Heart stiffness stops getting worse, and symptoms stabilize or improve slowly.

SAFETY WATCH

Generally well tolerated with few side effects. · Very expensive—insurance coverage can be an issue. · Does not help other types of cardiomyopathy or amyloidosis—must confirm ATTR-CM with biopsy or imaging before starting.

Patisiran or inotersen · Transthyretin gene silencer (RNAi or antisense oligonucleotide)

These drugs are used for hereditary transthyretin amyloidosis (hATTR) with nerve or heart involvement. They work by silencing the gene in the liver that makes transthyretin protein. Patisiran uses RNA interference (RNAi) to destroy the messenger RNA before it can make TTR protein; inotersen uses an antisense oligonucleotide to block the RNA. Either way, the liver makes much less transthyretin, so there is less protein available to misfold and form amyloid. This slows disease progression and can improve nerve and heart symptoms.

1. The drug enters liver cells and finds the messenger RNA (mRNA) for transthyretin.

2. Patisiran chops up the mRNA (RNAi pathway); inotersen binds and blocks the mRNA (antisense).
3. The liver produces much less transthyretin protein (up to 80–90% reduction).
4. With less TTR in the blood, there is less substrate to form new amyloid deposits.
5. Nerve and heart damage slows or stops; some symptoms may improve.

SAFETY WATCH

Patisiran: infusion reactions (flush, back pain, nausea during IV infusion)—premedicate with steroids and antihistamines. Can lower vitamin A—supplement if needed. · Inotersen: risk of low platelets (thrombocytopenia) and kidney damage (glomerulonephritis)—requires frequent blood and urine monitoring. Available only through a REMS program. · Both are very expensive and require specialized centers.

Deferoxamine, deferasirox, or deferiprone · Iron chelator

These drugs are used when cardiomyopathy is caused by iron overload (hemochromatosis or repeated blood transfusions, like in thalassemia). Too much iron deposits in the heart muscle, causing damage, stiffness, and eventually heart failure. Iron chelators bind to excess iron in the blood and tissues and help the body get rid of it through urine or stool. By lowering iron levels, they prevent further heart damage and can improve heart function over time.

1. The chelator binds tightly to free iron (forming a stable complex).
2. The iron-chelator complex is filtered by the kidneys (deferoxamine, deferasirox) or excreted in stool (deferiprone).
3. Total body iron decreases over weeks to months.
4. Oxidative stress and direct toxicity to heart muscle decrease.
5. Heart stiffness and dysfunction improve if treatment is started early.

SAFETY WATCH

Deferoxamine: given by slow IV or subcutaneous infusion (inconvenient). Can cause vision or hearing problems with long-term use—monitor regularly. · Deferasirox: taken by mouth (more convenient). Can harm kidneys or liver—check blood and urine tests regularly. · Deferiprone: taken by mouth. Can cause low white blood cells (agranulocytosis)—check blood counts weekly, especially in the first year. · All can cause nausea, stomach pain, or diarrhea.

Prednisone or methylprednisolone · Corticosteroid

Steroids are used when cardiomyopathy is caused by inflammation—for example, in sarcoidosis (abnormal immune clumps called granulomas) or giant cell myocarditis (severe heart

inflammation). Steroids turn down the immune system, reducing inflammation, swelling, and damage to the heart muscle. By calming the immune attack, they can stop progression and sometimes improve heart function, especially if started early.

1. Steroids enter cells and bind to glucocorticoid receptors.
2. This turns on anti-inflammatory genes and turns off pro-inflammatory genes.
3. Immune cells (T cells, macrophages) become less active and release fewer inflammatory signals.
4. Swelling and scarring in the heart muscle decrease.
5. Heart function stabilizes or improves if the inflammation is caught early.

SAFETY WATCH

Long-term use causes many side effects: high blood sugar (can cause diabetes), weight gain, mood changes, weakened bones (osteoporosis), higher infection risk, high blood pressure, cataracts, stomach ulcers. · Do NOT stop suddenly after long-term use—taper slowly to let the body's own cortisol production restart. · Watch for infections—steroids hide symptoms (less fever, less pain) so infections can get worse before you notice. · Monitor blood sugar, blood pressure, bone density, and eye health during long-term treatment.

Digoxin · Cardiac glycoside

Digoxin is an older drug sometimes used in heart failure (including dilated cardiomyopathy) to help control heart rate and improve symptoms—though it does NOT reduce mortality. It works by blocking the sodium-potassium pump in heart cells, which indirectly raises calcium inside the cell. More calcium means a slightly stronger contraction. Digoxin also slows the heart rate by increasing vagal (parasympathetic) tone, which is helpful in atrial fibrillation (an irregular, quivering heartbeat). It is used mainly when other drugs are not enough or when rate control is needed.

1. Digoxin blocks the sodium-potassium pump (Na^+/K^+ -ATPase).
2. Sodium builds up slightly inside the cell.
3. The sodium-calcium exchanger (which normally trades sodium in for calcium out) runs backward, keeping more calcium inside.
4. More calcium is available for contraction, so the heart squeezes a bit harder.
5. Digoxin also increases vagal tone, slowing conduction through the AV node and lowering heart rate.

SAFETY WATCH

Narrow therapeutic window—easy to get toxic levels. Check blood levels, kidney function, and potassium regularly. · Toxicity causes nausea, vomiting, confusion, vision changes (yellow halos), dangerous arrhythmias (like heart block or ventricular a fast heart rate (tachycardia)). · Low potassium or low magnesium increases toxicity risk—replace if low. · Drug interactions: many drugs raise digoxin levels (amiodarone, verapamil, clarithromycin). · Less commonly used now because newer drugs (like sacubitril-valsartan, SGLT2 inhibitors) work better.

Ivabradine · If channel blocker (heart rate reducer)

Ivabradine is used in heart failure (including some dilated cardiomyopathies) when the heart rate stays too fast despite a beta-blocker, or when a patient cannot tolerate a full dose of beta-blocker. It works by blocking the 'funny current' (If) in the sinus node—the heart's natural pacemaker. By slowing the firing rate of the pacemaker, it lowers heart rate without affecting the force of contraction or blood pressure. A slower heart rate gives the heart more time to fill and rest, which can improve symptoms and reduce hospitalizations.

1. Ivabradine blocks HCN channels (hyperpolarization-activated cyclic nucleotide-gated channels) that carry the If current.
2. The sinus node fires more slowly.
3. Heart rate drops (goal is around 50–60 beats per minute).
4. The heart has more time to fill with blood between beats.
5. Over time, heart function may improve and symptoms lessen.

SAFETY WATCH

Can cause visual side effects (flashes of light, brightness in part of the visual field)—usually mild and go away over time. · Do NOT use if resting heart rate is already below 60 or if you have severe low blood pressure. · Can worsen atrial fibrillation (an irregular, quivering heartbeat) if used alone—always combine with a beta-blocker in heart failure. · Not safe during pregnancy or breastfeeding.

Hydralazine and isosorbide dinitrate (used together) · Vasodilator combination

This combination is used in heart failure (including dilated cardiomyopathy) when a patient cannot take an ACE inhibitor, ARB, or ARNI (because of kidney problems, high potassium, or allergies). Hydralazine relaxes arteries directly, lowering the resistance the heart has to pump against. Isosorbide dinitrate relaxes veins, reducing the volume of blood returning to the heart (preload). Together, they reduce the heart's workload. Studies show this combination improves

survival and symptoms, especially in Black patients, who may respond better to this combination than other groups.

1. Hydralazine relaxes smooth muscle in artery walls by releasing nitric oxide or acting on calcium channels.
2. Isosorbide dinitrate is converted to nitric oxide, which relaxes veins.
3. Arteries widen (less afterload—easier for the heart to push blood out).
4. Veins widen (less preload—less blood filling the heart).
5. The heart pumps against less resistance and gets less overstretched.

SAFETY WATCH

Hydralazine can cause headaches, fast heart rate, fluid retention, and (rarely) drug-induced lupus with long-term use. · Isosorbide dinitrate can cause headaches (often severe at first), dizziness, and low blood pressure. · Tolerance can develop to nitrates—may need a nitrate-free period each day. · Check for anemia and monitor for lupus symptoms (joint pain, rash) on long-term hydralazine.

Verapamil or diltiazem · Non-dihydropyridine calcium channel blocker

These drugs are sometimes used in hypertrophic cardiomyopathy (HCM) when the heart muscle is thick and stiff, especially if the patient cannot tolerate a beta-blocker or needs help with heart rate control in atrial fibrillation (an irregular, quivering heartbeat). They block calcium channels in heart muscle and the conduction system, which relaxes the muscle, slows the heart rate, and improves filling (diastolic function). However, they are NOT used in obstructive HCM because they can worsen the outflow obstruction by dilating blood vessels and lowering blood pressure too much.

1. The drug blocks L-type calcium channels.
2. Less calcium enters heart muscle cells during each beat.
3. The heart relaxes better between beats (improved diastolic filling).
4. Conduction through the AV node slows, lowering heart rate.
5. Blood vessels relax slightly, lowering blood pressure.

SAFETY WATCH

Can worsen heart failure or cause dangerous low blood pressure in people with weak hearts—avoid in systolic heart failure. · Can cause constipation (especially verapamil), swelling in the legs, dizziness, or slow heart rate. · Drug interactions: raise levels of digoxin, statins, and many other drugs. · Do NOT combine with a beta-blocker without careful monitoring—can cause severe a slow heart rate (bradycardia) or heart block.

Red flags

- Sudden fainting without warning, especially during exercise
- New or worsening chest pain that does not go away with rest
- Severe shortness of breath at rest or gasping for air
- Rapid weight gain (2-3 pounds in one day or 5 pounds in one week) from fluid buildup
- Rapid or very irregular heartbeat with dizziness or near-fainting

Nursing priorities

1. Monitor oxygen saturation continuously and keep SpO₂ above 90% with supplemental oxygen if needed. — The weakened heart muscle cannot pump enough oxygen-rich blood to the body, and low oxygen worsens shortness of breath and forces the heart to work even harder, creating a dangerous cycle.
2. Weigh the patient daily at the same time in similar clothing and report gains of 2-3 pounds in one day or 5 pounds in one week immediately. — Daily weights catch fluid retention early before severe pulmonary edema (fluid flooding the lungs) (fluid in the lungs) develops, because each pound of weight gain equals about 500 mL of retained fluid that the failing heart cannot clear.
3. Place the patient in high Fowler position (sitting upright at 60-90 degrees) or a position of comfort that eases breathing. — Sitting upright uses gravity to shift fluid out of the lungs and down into the legs, reducing pulmonary congestion (fluid backup in lung blood vessels) and decreasing the work of breathing.
4. Monitor intake and output strictly, restricting fluids to 1.5-2 liters per day if ordered, and limit sodium to less than 2 grams daily. — The damaged heart cannot handle excess fluid volume, and high sodium makes the kidneys hold onto water, so restricting both prevents fluid overload that worsens heart failure symptoms and lung congestion.
5. Administer prescribed diuretics (furosemide or bumetanide) on time, monitor potassium and magnesium levels, and watch urine output closely. — Loop diuretics remove excess fluid through the kidneys to reduce preload (volume returning to the heart), but they also wash out potassium and magnesium, which can trigger dangerous arrhythmias if levels drop too low.
6. Monitor continuous telemetry (heart rhythm monitor) for arrhythmias, especially atrial fibrillation (an irregular, quivering heartbeat), ventricular a fast heart rate (tachycardia), or heart block. — Sick heart muscle cells fire electrical signals irregularly and stretched heart chambers trigger dangerous rhythms, and cardiomyopathy patients are at very high risk for sudden cardiac arrest from ventricular arrhythmias.

7. Assess for signs of poor blood flow (perfusion) (circulation): cool extremities, delayed capillary refill longer than 3 seconds, low blood pressure, confusion, or decreased urine output below 30 mL per hour. — When the heart muscle pumps too weakly, vital organs do not get enough oxygenated blood—the brain becomes confused, kidneys stop making urine, and skin turns cold as blood is shunted away to protect the heart and brain.
8. Teach the patient to balance rest with light activity, avoid Valsalva maneuvers (straining during bowel movements), and recognize worsening symptoms that need immediate medical attention. — Straining increases intrathoracic pressure (pressure in the chest), which reduces blood return to the already weak heart and can trigger fainting (syncope) or arrhythmias, while early symptom recognition prevents hospital readmission and sudden decompensation (rapid worsening).

Sources

- AHA/ACC 2020 Guideline for the Diagnosis and Treatment of Cardiomyopathy
- European Society of Cardiology (ESC) 2023 Cardiomyopathy Guidelines
- American College of Cardiology (ACC) Expert Consensus
- Cochrane Reviews on Heart Failure Management

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