

Multisystem Inflammatory Syndrome in Children

Multisystem Inflammatory Syndrome in Children (MIS-C)

THE ONE-LINE TRUTH

A child's immune system misfires 2-6 weeks after COVID, attacking the body instead of finishing cleanup — inflammation floods everywhere at once, mimicking Kawasaki disease but hitting older kids harder.

The chain — how it unfolds

1. COVID-19 clears, but the immune system never shuts down — regulatory T cells (Tregs, the specialized cells that tell the immune system to stand down) fail and cytokines (IL-6, IL-1 beta, TNF-alpha — powerful alarm chemicals) flood the bloodstream. — why: The virus is gone, but the immune alarm stays on. Without the normal 'all clear' signal from Tregs, inflammatory chemicals keep pouring out as if the threat is still present, priming every organ for attack.
2. Cytokines attack the endothelium (the thin inner lining of every blood vessel, like the coating inside a pipe), causing widespread vascular inflammation and capillary leak (fluid seeps out of vessels into surrounding tissue). — why: The lining of every blood vessel swells and becomes porous like a leaky sponge — fluid seeps out into tissues, blood pressure drops, and clotting factors (proteins in the blood that form clots) get activated, setting up for shock and dangerous clots.
3. The heart muscle (myocardium, the thick muscular walls of the heart) becomes inflamed (myocarditis, inflammation of the heart muscle), weakening its pump and causing chest pain, elevated troponin (a blood marker of heart muscle damage), and falling ejection fraction (the percentage of blood pumped out each beat drops). — why: Inflammatory cells — T cells and macrophages — invade the heart muscle, damaging the myocytes (the cells that contract to squeeze blood out with each beat). The heart struggles to keep up, and pump failure looms.

4. The coronary arteries (the small arteries that wrap around the heart and feed it oxygen and nutrients) dilate (widen abnormally) and risk forming aneurysms (permanent balloon-like weak spots in the artery wall). — why: Inflammation weakens the walls of the coronary arteries, causing them to stretch and bulge — aneurysms can clot off (thrombosis, where a blood clot blocks the artery) or rupture (burst), starving the heart muscle of oxygen and causing a heart attack.
5. Shock develops: first warm shock (high heart rate, wide-open vessels, warm skin, strong pulses) then cold shock (weak heart, low output, cold clammy skin, weak pulses, organ failure). — why: Early, the body compensates by revving the heart (tachycardia) and dilating vessels (vasodilation) to keep blood moving despite leaky pipes — but as the heart weakens from myocarditis and fluid leaks everywhere (capillary leak), compensation breaks and blood pressure crashes into life-threatening shock.
6. Organs begin to fail: kidneys (rising creatinine, low urine output called low urine output (oliguria)), liver (elevated AST and ALT enzymes), gut (severe pain, bloody diarrhea), and brain (confusion, headache, irritability). — why: With poor blood flow (hypoperfusion) and ongoing inflammation, every organ is starved of oxygen and nutrients while being bathed in toxic cytokines — cells start dying, and multi-organ failure accelerates.
7. Without treatment — IVIG (intravenous immunoglobulin, a mix of antibodies that neutralizes cytokines and calms the immune system), steroids (strong anti-inflammatory drugs like methylprednisolone that shut down cytokine production), and supportive care (fluids, pressors like norepinephrine to raise blood pressure, inotropes like milrinone to strengthen the heart) — the cytokine storm and cardiac damage spiral toward irreversible shock, coronary clot formation (thrombosis) (clots in the heart arteries), or death. — why: The body's own attempt to fight an enemy that isn't there becomes the disease itself — you must shut down the hyperinflammation with immune-calming drugs and support the heart and circulation before permanent organ damage or death occurs.
8. With prompt treatment, most children recover fully, though some need long-term cardiology follow-up for coronary artery changes (monitoring for late clotting, narrowing (stenosis), or persistent aneurysms). — why: Catching MIS-C early and hitting the inflammation hard allows the immune system to reset, the heart to heal, and the blood vessels to recover — but any coronary aneurysms that formed need monitoring with echocardiograms (ultrasound of the heart) for months to years to watch for late clotting or narrowing that could cause a heart attack down the road.

Spot it — what you see, and why

- Fever lasting several days (usually 3 or more): Two to six weeks after fighting off COVID, the immune system gets confused and releases a huge wave of inflammation signals called cytokines (chemical messengers that turn on the body's defense system) — these signals crank up the body's thermostat in the hypothalamus (the brain's temperature control center) to make heat, creating a stubborn fever that will not break.
- Belly pain, throwing up, or diarrhea: The cytokine storm inflames the lining of the stomach and intestines (the mucosa) — the swollen tissue slows down digestion, traps gas and fluid, and irritates the nerve endings that trigger cramping, nausea, and urgent, loose stools.
- Rash, very red and cracked lips, and a bright red bumpy tongue (strawberry tongue): Inflammation damages the tiny blood vessels (capillaries) just under the skin, leaking fluid and red cells that show up as patches of rash; at the same time, the mucous membranes in the mouth swell, making the tongue puffy with big, red taste bumps (papillae) and causing lips to crack and redden.
- Red, bloodshot eyes without any gunk or yellow discharge: The clear membrane covering the white of the eye (the conjunctiva) becomes inflamed from the immune overreaction — the tiny blood vessels there swell and shine through as red streaks, but because there is no real infection, no bacteria or viruses are present to make pus or sticky discharge.
- Swollen, puffy hands or feet: Inflammation weakens the walls of small blood vessels in the hands and feet, allowing fluid from the blood to leak out into the surrounding tissue (edema) — this extra fluid pools under the skin and puffs up the fingers, palms, toes, and soles.
- Swollen lymph nodes in the neck: Lymph nodes are tiny bean-shaped filters packed with immune cells — when the immune system is on overdrive, the nodes fill with extra white blood cells trying to fight the inflammation, swelling into tender lumps you can feel under the jaw or along the neck.

Red flags — act now

- Chest pain, trouble breathing, or very fast breathing — the heart muscle or lungs may be severely inflamed and struggling to work, risking heart failure or dangerous drops in oxygen.
- Confusion, extreme drowsiness, or difficulty waking the child — blood pressure may be dangerously low, starving the brain of oxygen and signaling possible shock.
- Severe belly pain that does not go away — inflammation may be causing dangerous swelling, fluid buildup in the abdomen, or even damage to organs like the pancreas or liver.
- Pale, cold, or blotchy skin with a weak, racing pulse — signs that blood pressure has dropped so low the body is going into shock and cannot deliver blood to vital organs.

- Little or no urine output for many hours — the kidneys are not getting enough blood flow and may be starting to fail (acute kidney injury).

Treat it — in this order

1. Intravenous immunoglobulin (IVIG), typically 2 g/kg as a single infusion over 8–12 hours → Floods the bloodstream with ready-made antibodies pooled from thousands of healthy donors. These antibodies neutralize the runaway inflammatory signals (cytokines like IL-1, IL-6, TNF-alpha) and block the Fc receptors on immune cells (macrophages, neutrophils) that keep pumping out more inflammation. This calms the hyperinflammation, reduces fever, and protects blood vessels and organs from further damage.
2. Corticosteroids (methylprednisolone 1–2 mg/kg per day IV, or equivalent dose of dexamethasone or prednisolone) → Shuts down the genes inside immune cells (T cells, macrophages) that code for inflammatory cytokines (IL-1, IL-6, TNF-alpha). Steroids bind to receptors in the nucleus of the cell and block the DNA from making more inflammatory proteins. This stops the immune cells from pumping out more signals, reduces swelling in blood vessel walls (the endothelium) and organs, and lets the heart, lungs, and gut recover function.
3. Aspirin (anti-inflammatory dose 30–50 mg/kg per day divided into 4 doses in the acute phase, then low-dose 3–5 mg/kg per day once daily for antiplatelet effect) → Blocks cyclooxygenase (COX-1 and COX-2) enzymes inside cells, which stops the body from making prostaglandins (chemicals that drive inflammation, fever, and pain) and thromboxane (a chemical that makes platelets sticky and clump together). High-dose aspirin reduces vessel inflammation and fever. Low-dose aspirin prevents clots from forming in inflamed or swollen coronary arteries.
4. Supportive care in the intensive care unit: continuous cardiorespiratory monitoring, oxygen, IV fluid boluses to maintain blood pressure, and sometimes inotropes (medicines like milrinone, epinephrine, or dobutamine to help the heart squeeze) or mechanical ventilation → Keeps oxygen flowing to the brain, kidneys, and other vital organs while the immune system calms down. IV fluid boluses (10–20 mL/kg of normal saline or lactated Ringer's) fill the blood vessels to support blood pressure if the child is in shock. Inotropes help a struggling heart pump harder by making the muscle contract more forcefully or relaxing the vessels so the heart doesn't have to push as hard. Mechanical ventilation takes over breathing if the lungs are too inflamed or full of fluid to work on their own.

5. Serial echocardiograms and cardiac biomarkers (troponin, BNP or NT-proBNP) monitoring—initially at diagnosis, then at 1–2 weeks and 4–6 weeks → Detects early signs of myocarditis (heart muscle inflammation), weak pumping (low ejection fraction), or swelling in the coronary arteries (aneurysms defined as z-score ≥ 2.5). Catching these changes early lets the care team escalate therapy—add stronger immunosuppression (like the IL-1 blocker anakinra or IL-6 blocker tocilizumab) or start anticoagulation—before the heart fails or a clot blocks a coronary artery.

Your top priorities at the bedside

1. Place child on continuous cardiac monitor and pulse oximeter, measure blood pressure every 1 to 2 hours — why: MIS-C causes myocarditis (heart muscle inflammation) and can quickly lead to arrhythmias (irregular heartbeat), low cardiac output (weak heart pumping), and shock (dangerously low blood pressure). Early detection allows immediate treatment before cardiac arrest.
2. Establish large-bore IV access and monitor strict intake and output every hour — why: Children with MIS-C often need rapid fluid resuscitation (giving IV fluids quickly) for shock, plus IVIG (intravenous immunoglobulin) infusions. Tracking fluid balance prevents overload that worsens heart failure while ensuring adequate kidney blood flow (perfusion) (blood flow to kidneys).
3. Assess for signs of shock: cold hands and feet, delayed capillary refill over 3 seconds, weak pulses, low urine output under 1 mL/kg/hour — why: MIS-C causes vasodilatory shock (blood vessels relax too much) and cardiogenic shock (heart too weak to pump). Catching early shock allows vasopressor (blood pressure medicine) support before organ damage occurs.