

Electrical Injury

A plain-English guide for you and your family

WHAT IS HAPPENING

Your skin acts like a protective shield that resists electricity. When a tiny shock happens—like static from a doorknob—your skin stops most of it and you feel just a quick zap. But when a strong current breaks through that shield, electricity flows through your body like water through pipes, following the path of least resistance—usually through blood vessels, nerves, and muscles. You may see small burn marks where the current entered (like from a hand touching a wire) and where it exited (often the foot touching the ground). The dangerous part is that the burns you can see are just the tip of the iceberg. Deep inside, that same current has cooked muscles, damaged nerves, and can scramble the heart's electrical rhythm or even stop it completely. The jolt can throw you backward, causing falls and broken bones. Damaged muscle releases a protein called myoglobin into your blood, which can clog your kidneys like coffee grounds blocking a filter. Cooked muscle inside tight arm or leg compartments swells up, squeezing off blood flow like a tourniquet. Even if someone looks okay at first, these hidden injuries can show up hours later. That's why every electrical injury—even if it seems minor—needs a doctor to check the heart, muscles, and kidneys, because what you cannot see on the outside may be serious on the inside.

What you might feel

- Skin burns at entry and exit points
- Muscle pain, swelling, or weakness in arms or legs
- Heart rhythm problems (arrhythmias) or cardiac arrest
- Numbness, tingling, or loss of movement
- Confusion, memory loss, or seizures
- Dark or cola-colored urine
- Broken bones or dislocated joints
- Lichtenberg figures (fern-like skin marks after lightning)
- Hearing loss or ruptured eardrums
- Breathing stops or becomes very slow

Call the doctor right away if...

- Heart rhythm is irregular, too fast, too slow, or the person has chest pain
- Urine is dark brown, red, or cola-colored (sign of muscle breakdown clogging the kidneys)
- Severe swelling, numbness, or pain in an arm or leg that gets worse (compartment syndrome building pressure)
- Confusion, seizures, or the person is unconscious or hard to wake up
- High-voltage exposure (power lines, industrial equipment) even if burns look small on the outside

What the care team will do

- Place patient on continuous cardiac monitor and obtain a 12-lead ECG immediately, watching for arrhythmias like ventricular fibrillation, ventricular a fast heart rate (tachycardia), or heart block.
- Start two large-bore IV lines and run lactated Ringer's or normal saline wide open, aiming for urine output greater than 200 mL per hour in adults (1 to 2 mL per kilogram per hour in children).
- Check urine color every void and send urine myoglobin level and serum creatine kinase (muscle enzyme) if urine is dark, tea-colored, or cola-colored.
- Assess all four limbs every 1 to 2 hours for the 6 P's of compartment syndrome: Pain out of proportion, Pressure or tightness, Pale skin (Pallor) (pale skin), Tingling or numbness (Paresthesias) (numbness or tingling), Pulselessness, and Paralysis (cannot move).
- Inspect entry and exit burn wounds, clean gently with sterile saline, apply sterile non-stick dressing, and do NOT apply ice or creams—document wound size, depth, and location with photos if available.
- Perform hourly neurological checks including level of consciousness, pupil reaction, speech clarity, arm and leg strength, and ask about headache, vision changes, or memory problems.
- Keep patient on bedrest with fall precautions, call light within reach, and assist with all movement for the first 24 hours even if patient feels fine.
- Hold all food and drink (NPO status) until cleared by provider, because patient may need emergency surgery for compartment syndrome, burn debridement, or other internal injuries.

Medicines you may be given — and why

Intravenous Crystalloid (Normal Saline or Lactated Ringer's)

When electricity damages muscle, the muscle cells break open and spill a protein called myoglobin into the blood. Myoglobin is like a sticky sludge that can clog the tiny filters in the kidneys and cause them to fail. IV fluids flush the kidneys like turning on a garden hose at full blast—they push lots of water through the kidneys so the myoglobin gets washed out in the urine before it can clog anything. The goal is to make the patient pee at least 75 to 100 milliliters every hour (about half a cup), keeping the urine clear and the kidneys safe.

Sodium Bicarbonate (Baking Soda IV Solution)

When myoglobin (the muscle protein released after electrical injury) reaches the kidneys, it is more likely to clump together and clog the filters if the urine is acidic (low pH). Sodium bicarbonate makes the urine more alkaline (higher pH)—like adding baking soda to water to make it less sour. In alkaline urine, myoglobin stays dissolved and flows out more easily instead of forming harmful clumps. The target is to keep the urine pH above 6.5, ideally around 7 to 8, so the kidneys stay clear and functional.

Mannitol

Mannitol is a sugar molecule that the kidneys cannot absorb back into the blood—it stays in the urine and acts like a sponge, pulling extra water into the urine. This creates a strong flow of urine (diuresis) that helps flush myoglobin out of the kidneys before it can clog the filters. Think of it like adding dish soap to a clogged drain to help push the blockage through. Mannitol also reduces swelling in damaged tissues, including muscles swollen from electrical injury, by pulling fluid out of the tissue and into the bloodstream where it can be urinated out.

Tetanus Toxoid Vaccine (Td or Tdap Booster)

Electrical burns create open wounds, and any open wound can let tetanus bacteria (*Clostridium tetani*) enter the body from dirt or debris. Tetanus bacteria make a poison (toxin) that locks up the muscles, causing painful spasms and potentially fatal breathing problems. The tetanus vaccine teaches the immune system to recognize and attack the tetanus toxin before it can cause harm. If the patient has not had a tetanus shot in the past 5 years (for dirty wounds) or 10 years (for clean wounds), a booster dose is given to refresh the immune system's memory and provide protection.

Tetanus Immunoglobulin (TIG)

Tetanus immunoglobulin is a solution of ready-made antibodies (proteins that fight tetanus toxin) collected from human donors who already have immunity. Unlike the vaccine, which takes days to work because your body has to build its own antibodies, TIG gives you instant

protection by providing antibodies right away. These antibodies grab onto any tetanus toxin in the body and neutralize it immediately, like a fire extinguisher putting out a fire before it spreads. TIG is used for patients who have never been vaccinated, have an incomplete vaccination series, or have a very dirty or deep wound where tetanus risk is high.

Where this information comes from

- American Burn Association
- AHA/ACC guidelines on cardiac arrest and arrhythmias
- National Institute for Occupational Safety and Health (NIOSH)
- Wilderness Medical Society practice guidelines for lightning injuries

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