

Candidemia

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THE STORY IN ONE SENTENCE

Candida in the bloodstream is a serious fungal infection that requires immediate antifungal treatment, usually with an echinocandin drug.

“Candidemia means the yeast Candida—which normally lives harmlessly on your skin and in your mouth—has gotten into the bloodstream where it does not belong, and the source matters as much as treating it.”

Normal anatomy — the body's job

Candida is a yeast that normally lives on your skin, in your mouth, and in your intestines without causing harm. Your immune system and the good bacteria in your body keep it under control. Blood is supposed to be completely sterile—no germs, no yeast, nothing living in it. The body has strong barriers (like skin and the gut lining) to keep Candida out of the bloodstream.

BODY'S JOB

The immune system's job is to recognize and destroy invaders like bacteria and yeast. White blood cells patrol the blood and tissues, killing germs before they can multiply. The skin acts as a physical wall, and the gut lining forms a tight barrier so that yeast and bacteria stay inside the intestines and do not leak into the blood. Good bacteria in the gut and on the skin compete with Candida for space and food, keeping the yeast population small and harmless. When all these defenses work together, Candida stays where it belongs and never gets into the bloodstream.

1. Candida yeast lives peacefully on the skin surface, in the mouth, and inside the gut, like quiet neighbors.
2. The skin forms a tough, unbroken barrier—like a brick wall—so yeast cannot get through to the blood vessels underneath.

3. The gut lining is made of tightly joined cells that act like a sealed fence, keeping yeast and bacteria inside the intestines.
4. White blood cells (neutrophils, T cells, and macrophages) constantly patrol the blood and tissues, ready to attack and eat any yeast that slips through.
5. Good bacteria (like *Lactobacillus* and *Bifidobacterium*) crowd out *Candida* in the gut and on the skin, limiting how much yeast can grow.
6. Blood flows through veins and arteries completely clean and sterile, with no fungi, bacteria, or other germs floating in it.

What breaks

Candidemia happens when *Candida* yeast crosses from the skin or gut into the bloodstream, where it does not belong. This usually requires a combination of broken barriers (like a tube punching through the skin or a leaky gut) and a weakened immune system that cannot kill the yeast fast enough.

CLINICAL TERM

Candidemia is invasive candidiasis caused by hematogenous dissemination of *Candida* species, most commonly *C. albicans*, *C. glabrata*, *C. parapsilosis*, *C. tropicalis*, or *C. auris*. The yeast enters the bloodstream through disrupted mucocutaneous barriers (central venous catheters, gastrointestinal translocation, urinary catheters) or as a result of impaired host defenses (neutropenia, corticosteroids, chemotherapy, broad-spectrum antibiotics, total parenteral nutrition, diabetes). Once in the blood, *Candida* can disseminate to distant organs, causing deep-seated infections such as endocarditis, endophthalmitis, osteomyelitis, meningitis, and hepatosplenic candidiasis. The downstream clinical picture includes fever, sepsis, low blood pressure (hypotension), and organ-specific manifestations. All findings trace back to this upstream break: loss of barrier integrity and immune surveillance that allowed commensal yeast to become an invasive pathogen.

How the body compensates

Once *Candida* is in the bloodstream, the body launches an emergency response to try to contain and kill the yeast. Fever rises to slow fungal growth. White blood cells rush to the site and release chemicals (cytokines) that cause inflammation, trying to wall off the invader. Blood vessels become leaky to let more immune cells reach infected tissues. The heart pumps faster and blood pressure may drop as the body redirects resources to fight the infection. These are all signs that the body is working hard to compensate—but they are also signs that the

infection is serious. Vital signs can look deceptively stable for a while, but untreated candidemia will overwhelm these defenses, leading to septic shock, organ failure, and death.

1. Fever spikes (often above 101°F or 38.3°C) as the immune system releases chemicals called pyrogens (like interleukin-1 and tumor tissue death (necrosis) factor) to raise body temperature, which slows down yeast growth and speeds up immune cell activity.
2. White blood cells (neutrophils and macrophages) swarm to the bloodstream and tissues, trying to engulf and kill *Candida*—but if there are too few white cells or the yeast is protected in a biofilm, this response may fail.
3. Blood vessels become leaky (increased vascular permeability) to let immune cells and fluid move from blood into infected tissues—this is why patients can develop low blood pressure (hypotension) and need IV fluids or medicines to keep blood pressure up (vasopressors like norepinephrine).
4. The heart beats faster (tachycardia) to pump more blood and deliver oxygen and immune cells to organs under attack, but this compensation costs energy and cannot be sustained for long.
5. The body walls off *Candida* in abscesses (pockets of pus) in the liver, spleen, kidneys, or brain—this is the immune system's last-ditch effort to trap the yeast and keep it from spreading further, but it also means the infection is deep and hard to reach with medicine.
6. Watch for the dangerous tipping point: despite aggressive fluid resuscitation and vasopressors, blood pressure stays low (septic shock); oxygen levels drop because the lungs are inflamed (acute respiratory distress syndrome, ARDS); kidneys shut down (acute kidney injury); or the patient becomes confused and unresponsive (altered mental status from sepsis or brain infection). These are signs that compensation is failing.
7. A patient with stable vital signs but persistent fever, a central line still in place, and no antifungal treatment is on a slow downhill slide—vital signs can mask the seriousness until the body suddenly decompensates and crashes.

Domino effect

1. *Candida* enters the bloodstream through a central line, leaky gut, or other breach in the body's barriers. — The yeast is now in a place it does not belong—sterile blood—and begins to multiply and travel throughout the body. This is the upstream event that triggers everything else.
2. Fever and chills develop, often spiking high and suddenly (rigors—shaking chills). — The immune system detects foreign yeast cells in the blood and releases chemicals (cytokines like IL-1, IL-6, TNF-alpha) that reset the body's thermostat in the brain (hypothalamus), raising temperature to slow yeast growth and rev up immune defenses.

3. Sepsis develops: blood pressure drops, heart rate climbs, breathing gets faster, and the patient may become confused or sleepy. — The immune system's response to *Candida* in the blood is so strong that it causes widespread inflammation. Blood vessels dilate and become leaky, fluid shifts out of vessels into tissues, and blood pressure falls. The heart races to compensate, but organs begin to suffer from poor blood flow and oxygen delivery (hypoperfusion and low oxygen (hypoxia)).
4. *Candida* seeds itself in the eye (endophthalmitis), causing blurry vision, floaters, or eye pain. — Yeast cells travel through the bloodstream to the tiny blood vessels in the retina (back of the eye) and start growing there. The eye is rich in blood flow and relatively protected from the immune system, making it a common target. Without treatment, this can cause permanent blindness.
5. *Candida* grows on heart valves (endocarditis), especially in people with artificial valves, damaged valves, or central lines near the heart. — Yeast cells stick to the rough or damaged surface of a heart valve and form a clump (vegetation) of yeast, immune cells, and blood clot material. This vegetation can break off and travel to the brain (stroke), block blood flow through the heart, or destroy the valve, causing heart failure.
6. Abscesses (pockets of pus) form in the liver, spleen, kidneys, brain, bones, or muscles. — *Candida* lands in these organs through the bloodstream, and the immune system tries to wall it off by forming a thick capsule of inflammatory tissue and pus around the yeast. These abscesses can grow large, press on nearby structures, and are hard to penetrate with antifungal drugs, often requiring weeks of treatment or surgical drainage.
7. Despite antifungal treatment, fever persists or the patient worsens—this often means the central line is still in place, an abscess has formed, or the yeast is resistant to the antifungal drug. — *Candida* in a biofilm on a central line is protected from both the immune system and antifungal drugs—removing the line is essential. Deep abscesses may need surgical drainage. Some *Candida* species (like *C. glabrata* or *C. auris*) can be resistant to fluconazole or even echinocandins, requiring a switch to a different drug based on lab testing (antifungal susceptibility).
8. If untreated or treatment is delayed, candidemia leads to septic shock, multi-organ failure, and death. — The ongoing inflammation and infection exhaust the body's compensatory mechanisms. Blood pressure cannot be maintained even with fluids and vasopressors. Kidneys fail (acute kidney injury), lungs fill with fluid (ARDS), the liver stops making clotting factors (coagulopathy), and the brain shuts down (encephalopathy). Mortality for untreated candidemia is 40–60%, but early source control (line removal) and appropriate antifungal therapy (echinocandin first-line per IDSA guidelines) can reduce this to 20–40%.

Symptoms · what the patient feels, and why

- Fever that does not go away even when the person takes antibiotics: Candida is a fungus, not a bacterium, so antibiotics (which kill bacteria) cannot stop it. The body keeps fighting the yeast in the blood, which keeps causing fever.
- Chills and shaking: When yeast enters the bloodstream, the immune system releases chemicals called cytokines (alarm proteins) to fight the invader. These chemicals reset the body's thermostat higher, causing shaking chills as the body tries to warm up quickly.
- Low blood pressure (the person may feel dizzy or confused): The yeast and the body's strong immune response can damage the walls of blood vessels, making them leak fluid. This drops the pressure inside the vessels, like a garden hose losing water through tiny holes.
- Fast heart rate: When blood pressure drops or the body is fighting an infection, the heart pumps faster to try to deliver enough oxygen and nutrients to all the organs.
- Breathing faster than normal: The body needs more oxygen during a serious infection, and the lungs work harder to bring it in. Also, the blood may become more acidic (like lemon juice instead of water), which makes the breathing center in the brain speed up breathing to blow off extra carbon dioxide and balance the acid.
- Confusion or being less alert than usual: The brain needs a steady supply of oxygen and sugar. When blood pressure is low or the body is very sick, the brain may not get enough fuel, so thinking becomes foggy or the person may seem sleepy or disoriented.
- White patches or spots inside the eyes (seen by a doctor looking with a special light): Candida yeast in the blood can travel to the tiny blood vessels in the back of the eye (the retina) and form little clumps or abscesses (pockets of infection). These look like white or yellowish spots. This is called endophthalmitis.
- Skin bumps or nodules (small lumps under the skin): Sometimes the yeast spreads from the blood into the skin, forming small infected spots that look like red or purple bumps. This happens when the yeast seeds (plants itself) in many places around the body.

Focused exam

- Fever that keeps going even after several days of antibiotics that kill bacteria: Candidemia is a fungus infection in the blood. Antibiotics only kill bacteria, not fungi, so the fever stays because the body is still fighting a yeast that the medicine cannot touch.
- Central line (a plastic tube in a big vein) that has been in place for days or weeks, especially if the skin around it is red, swollen, or draining pus: The central line is the main road Candida uses to get from the skin into the bloodstream. If the line stays in, the fungus keeps streaming in. Removing or replacing the line is one of the most important steps to stopping candidemia.

- White fluffy spots or haze inside the back of the eye (retina) seen on dilated eye exam: Candida from the blood can travel to the eye and grow on the retina, causing endophthalmitis (infection inside the eyeball). This tells you the fungus has spread beyond the blood and is seeding other organs. If not treated quickly, it can cause blindness.
- New heart murmur (whooshing sound when listening to the heart) or a vegetation (a clump of fungus and clot) seen on an echocardiogram: Candida can stick to heart valves and grow there, causing endocarditis (infection of the heart lining). This is life-threatening because chunks can break off, block arteries, and cause strokes or organ damage. A new murmur in a patient with candidemia means the fungus has reached the heart.
- Pockets of pus (abscesses) in the liver, spleen, kidneys, or brain seen on CT scan or ultrasound: When Candida is in the blood, it acts like seeds blowing in the wind — it lands in different organs and starts growing there. Abscesses mean the infection has spread and dug in deep. Antifungal medicine alone cannot reach inside an abscess; you often need to drain it surgically or the infection will not clear.
- Very low white blood cell count (neutropenia, absolute neutrophil count below 500 cells per microliter) along with fever and yeast in the blood: White blood cells are the body's soldiers that fight infections. When the count is very low, the immune system cannot keep Candida in check, so the fungus spreads freely. Candidemia in a neutropenic patient is especially dangerous and needs urgent treatment.

Diagnostics · every test answers a question

- Blood cultures (two sets from different sites) → Is there a fungus or bacteria growing in the bloodstream right now?
- Candida species identification and antifungal susceptibility testing → Which type of Candida is it, and which antifungal medicines will kill it?
- Beta-D-glucan blood test → Is there a fungal infection present even if blood cultures have not grown yeast yet?
- Dilated ophthalmoscopy (eye exam by an ophthalmologist) → Has Candida spread from the blood to the eyes?
- Echocardiogram (ultrasound of the heart), preferably transesophageal (TEE) → Has Candida spread to the heart valves and caused endocarditis?
- CT scan of the abdomen and pelvis with IV contrast → Are there abscesses (pockets of pus and fungus) in the liver, spleen, kidneys, or other organs?

Treatment logic

- Start an echinocandin antifungal (caspofungin 70 mg loading dose then 50 mg daily, micafungin 100 mg daily, or anidulafungin 200 mg loading then 100 mg daily) immediately when blood culture grows yeast → Echinocandins punch holes in the cell wall of *Candida*, killing the fungus and stopping it from multiplying in the blood and seeding organs like the eyes, heart, and brain. They work faster and more reliably than fluconazole, especially against resistant species like *C. glabrata* and *C. auris*.
- Remove or replace all central venous catheters (central lines, PICC lines, dialysis catheters) within 24 to 48 hours → The plastic surface of a catheter is like a playground for *Candida* — the fungus sticks to it and forms a biofilm (a slimy coating) that protects it from antifungals and immune cells. Removing the line cuts off the main entry point and source of ongoing infection. Studies show patients whose lines are removed quickly are more likely to survive and clear the bloodstream faster.
- Ophthalmology exam (dilated fundoscopy) within the first week of diagnosis, repeated weekly if neutropenic or if candidemia lasts more than a few days → Finding *Candida* in the eye early allows treatment with intravitreal antifungals (medicine injected directly into the eye) or vitrectomy (surgery to remove infected fluid) before it destroys the retina and causes blindness. About 5 to 10 percent of candidemia patients develop eye involvement, and symptoms (blurry vision, floaters) may not appear until damage is already done.
- Continue echinocandin for at least 14 days after the last positive blood culture and resolution of symptoms, then consider switching to fluconazole 400 to 800 mg daily if the patient is stable and the *Candida* species is susceptible → Extended treatment kills any remaining yeast hiding in tissues and organs, preventing relapse. Switching to fluconazole after the critical phase allows easier dosing (oral pill or IV once daily) and is cheaper, but only works if the *Candida* is not resistant. For resistant species like *C. glabrata* or *C. auris*, you must stay on an echinocandin the whole time.
- Image and drain any abscesses (pockets of pus) found in the liver, spleen, kidneys, or other organs, especially if larger than 3 cm → Draining an abscess removes the thick pus and fungus that antifungals cannot reach. Without drainage, the infection will keep smoldering even with months of medicine. Drainage can be done with a needle guided by ultrasound or CT (percutaneous drainage) or with surgery if the abscess is in a hard-to-reach spot.
- Stop or narrow unnecessary antibiotics that kill bacteria; restore normal gut bacteria with enteral feeding if possible → Broad-spectrum antibiotics wipe out the good bacteria in the gut and on the skin that normally keep *Candida* in check. When those bacteria are gone, *Candida* overgrows and can leak through a damaged gut wall into the bloodstream. Stopping antibiotics and feeding the gut allows good bacteria to return and closes the door *Candida* was using.

- Transthoracic or transesophageal echocardiogram if candidemia lasts more than a few days, a new murmur appears, or the patient has a prosthetic heart valve or pacemaker → Finding Candida endocarditis (infection on a heart valve) changes the treatment plan to at least 6 weeks of antifungals and often requires valve replacement surgery. Missing it can lead to heart failure, stroke from clots breaking off, or death. TEE (camera passed down the esophagus) sees small vegetations better than a regular echo.

Medications

Caspofungin · Echinocandin antifungal

Blocks the fungus from building a strong cell wall. Without a strong wall, the Candida cell bursts and dies.

1. Caspofungin stops an enzyme called beta-1,3-glucan synthase inside the fungus cell.
2. This enzyme normally makes glucan, a sugar chain that forms the cell wall's backbone.
3. Without glucan, the wall becomes weak and full of holes.
4. The fungus cell swells, breaks open, and dies.

SAFETY WATCH

Watch liver enzyme blood tests (AST, ALT) weekly; the drug can raise them. · Rare: flushing, fever, or rash during the infusion—slow it down if this happens. · Tell the doctor if the patient takes cyclosporine or tacrolimus (immune drugs); caspofungin can change their levels.

Micafungin · Echinocandin antifungal

Blocks the fungus from building a strong cell wall. Without a strong wall, the Candida cell bursts and dies.

1. Micafungin stops beta-1,3-glucan synthase, the enzyme that makes glucan.
2. Glucan is the main building block of the Candida cell wall.
3. Without enough glucan, the wall cannot hold the cell together.
4. The fungus cell breaks apart and dies.

SAFETY WATCH

Check liver enzyme blood tests (AST, ALT) weekly; micafungin can raise them. · Watch for rash, itching, or facial swelling (rare allergic reaction). · Tell the doctor if the patient takes sirolimus or nifedipine; micafungin can increase their blood levels.

Anidulafungin · Echinocandin antifungal

Blocks the fungus from building a strong cell wall. Without a strong wall, the Candida cell bursts and dies.

1. Anidulafungin stops beta-1,3-glucan synthase inside the fungus.
2. This enzyme makes glucan, the sugar scaffold of the cell wall.
3. Without glucan, the wall collapses.
4. The Candida cell swells, ruptures, and dies.

SAFETY WATCH

Watch for liver enzyme changes (AST, ALT), though anidulafungin causes this less often than the other echinocandins. · Rare: infusion-related reaction (flushing, low blood pressure)—slow the infusion if it happens. · Generally well tolerated with few drug interactions.

Fluconazole · Azole antifungal

Stops the fungus from making ergosterol, a fat molecule it needs in its cell membrane. Without ergosterol, the membrane leaks and the fungus cannot grow.

1. Fluconazole blocks an enzyme called lanosterol 14-alpha-demethylase (part of the cytochrome P450 system) inside the fungus.
2. This enzyme normally converts lanosterol into ergosterol.
3. Without ergosterol, the membrane becomes unstable and full of the wrong fats.
4. The fungus cell cannot divide or survive.

SAFETY WATCH

Check liver enzyme tests (AST, ALT) weekly; fluconazole can damage the liver. · Tell the doctor about every other drug the patient takes—fluconazole blocks many liver enzymes and raises blood levels of warfarin, phenytoin, statins, and many others. · Watch for nausea, rash, or headache. · Do not use in pregnancy unless absolutely necessary; it can harm the baby's bones and heart at high doses.

Amphotericin B deoxycholate · Polyene antifungal

Punches holes in the fungus cell membrane by binding to ergosterol, a fat found only in fungus cells. The holes let cell contents leak out, and the fungus dies.

1. Amphotericin B sticks tightly to ergosterol in the fungal membrane.
2. It forms clusters that create pores (tiny channels) in the membrane.

3. Essential ions (potassium, magnesium) and small molecules leak out through the pores.
4. The fungus cell loses its balance and dies.

SAFETY WATCH

Infusion reactions are common: fever, shaking chills, low blood pressure—give acetaminophen, diphenhydramine, and sometimes hydrocortisone before the dose. · Kidney damage (nephrotoxicity) happens in most patients—check creatinine and electrolytes (potassium, magnesium) daily and give intravenous saline before each dose. · Watch for low potassium and low magnesium; replace them as needed. · Anemia (low red blood cells) develops over weeks of treatment. · Lipid formulations (liposomal amphotericin B, amphotericin B lipid complex) cause fewer kidney problems but cost much more.

Voriconazole · Azole antifungal

Stops the fungus from making ergosterol, a fat it needs in its cell membrane. Without ergosterol, the membrane leaks and the fungus cannot grow.

1. Voriconazole blocks the enzyme lanosterol 14-alpha-demethylase in the fungus.
2. This enzyme converts lanosterol into ergosterol.
3. Without ergosterol, toxic sterol precursors pile up in the membrane.
4. The membrane becomes unstable, and the fungus stops growing.

SAFETY WATCH

Check liver enzyme tests (AST, ALT) weekly; voriconazole can cause liver damage. · Visual changes are common: blurry vision, bright lights, color changes—usually mild and reversible, but tell the doctor. · Many drug interactions—voriconazole is metabolized by liver enzymes CYP2C19, CYP2C9, and CYP3A4 and also blocks them, so it changes levels of many other drugs. · Check voriconazole blood levels (trough) to make sure the dose is right—too low fails, too high causes toxicity. · Rare but serious: hallucinations, liver failure, skin reactions (rash, blistering). · Avoid in patients with severe kidney problems if using the intravenous form (the carrier molecule can accumulate).

Red flags

- Blood pressure drops suddenly (shock), meaning organs may not be getting enough blood
- The person becomes very confused, hard to wake up, or unresponsive
- White spots appear in the eyes (endophthalmitis), which can cause blindness if not treated quickly

- Signs of infection spreading to the heart valves, such as a new heart murmur or worsening heart failure
- Kidneys stop making urine or urine output drops sharply, a sign the kidneys are failing

Nursing priorities

1. Notify the provider immediately to start echinocandin antifungal within 1 hour of yeast growing in blood culture, and make sure the first dose is not delayed waiting for species identification. — Candida doubles mortality (death rate) every 12 hours treatment is delayed; echinocandins like caspofungin kill Candida faster than fluconazole and work even when the yeast is resistant, so early treatment saves lives and prevents organ damage.
2. Check blood pressure, heart rate, and mental status every 15 to 30 minutes until stable, watching for systolic BP below 90 or confusion, which signal septic shock requiring immediate fluid boluses and possible ICU transfer. — Candidemia causes systemic inflammation (whole-body reaction) that dilates blood vessels, dropping pressure so low that organs like the brain and kidneys do not get enough oxygen; catching shock early prevents multi-organ failure and death.
3. Coordinate with the provider and vascular access team to remove or replace all central lines, PICCs, and dialysis catheters within 24 to 48 hours of diagnosis, even if the line looks clean. — Candida forms biofilm (a slimy protective layer) on catheter surfaces that antifungals cannot penetrate; the yeast keeps seeding the bloodstream from this reservoir, so the infection will not clear until the line is removed.
4. Draw repeat blood cultures daily until two cultures in a row come back negative for yeast, using both peripheral sticks and draws from any remaining central lines. — Persistent candidemia (yeast still growing after 3 to 5 days of treatment) happens in 15 to 20 percent of cases and signals treatment failure, need for different antifungals, or hidden deep infection like endocarditis (heart valve infection) requiring imaging.
5. Schedule a dilated eye exam by ophthalmology within 1 week of diagnosis, and ask the patient daily about vision changes, explaining this is not optional even if eyes feel fine. — Endophthalmitis (Candida growing inside the eyeball) occurs in 5 to 10 percent of candidemia cases, often without symptoms at first; finding it early with fundoscopy (looking at the back of the eye) allows intravitreal antifungal injections that save vision.
6. Monitor intake and output strictly, report urine less than 0.5 mL per kg per hour for 2 hours, and watch labs for creatinine rising or potassium climbing above 5.5. — Septic shock and some antifungals like amphotericin damage kidney tubules (the filtering tubes); catching acute kidney injury early allows fluid adjustment and prevents the need for dialysis or switching to drugs that are harder on kidneys.

7. Assess for new heart murmurs every shift by listening to heart sounds, and report immediately if a murmur appears or the patient develops new shortness of breath or leg swelling. — Candida can seed heart valves and cause endocarditis (valve infection), especially in people with prosthetic valves or IV drug use; this complication requires 6 weeks of antifungals and sometimes valve surgery, so early echocardiogram imaging is critical.
8. Educate the patient that treatment lasts at least 14 days after the last positive blood culture, not just until fever goes away, and missing doses lets resistant Candida grow back. — Candidemia recurs (comes back) in 10 to 15 percent of cases if treatment stops too early; Candida hides in tissues like the spleen and liver, so the full course kills these hidden organisms and prevents relapse requiring hospitalization again.

Sources

- IDSA Clinical Practice Guideline for the Management of Candidiasis: 2016 Update
- CDC Guidelines for Prevention of Intravascular Catheter-Related Infections
- Infectious Diseases Society of America (IDSA)
- New England Journal of Medicine (NEJM) review on invasive candidiasis

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