

Croup

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THE STORY IN ONE SENTENCE

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“Croup is caused by a virus (usually parainfluenza) that swells the narrow airway below the voice box. Steroids shrink the swelling and help the child breathe easier.”

Normal anatomy — the body's job

The upper airway is a smooth, open tube that carries air from the nose and mouth down past the voice box (larynx) and into the windpipe (trachea), then into the lungs. In a young child, this tube is narrow—about the width of the child's pinky finger at its narrowest point, which is just below the voice box in an area called the subglottic space.

BODY'S JOB

The airway's job is to stay open and let air flow in and out easily with every breath. The walls of the airway are made of soft tissue and cartilage (firm but bendable material, like the tip of your nose) that hold the tube open. When air moves smoothly through this tube, breathing is quiet and easy. The voice box sits at the top of the windpipe and makes sound when air passes over the vocal cords. Because a young child's airway is so narrow, even a small amount of swelling on the inside can block a large part of the space and make breathing noisy and hard.

1. Air enters through the nose or mouth.
2. Air flows down the back of the throat (pharynx).
3. Air passes through the voice box (larynx), where the vocal cords sit.
4. Air travels through the subglottic space—the narrow part of the airway just below the voice box.
5. Air continues down the windpipe (trachea) and into the lungs.

6. In a healthy child, this entire path is wide open and air moves silently and easily in both directions.

What breaks

A virus (most often parainfluenza, but also RSV, influenza, adenovirus, or even a common cold virus) lands in the lining of the airway just below the voice box. The body's immune system recognizes the invader and sends white blood cells and fluid to the area to fight the infection. That immune response causes the soft tissue in the subglottic space to swell—like how your skin puffs up around a bug bite. Because a young child's airway is already narrow, even a few millimeters of swelling take up a large percentage of the open space. Air now has to squeeze through a much smaller hole, and fast-moving air through a narrow space makes noise—just like blowing through a tiny gap in your lips makes a whistle. That is why you hear the seal-bark cough and the high-pitched a high-pitched noise on breathing in (stridor) sound when the child breathes in.

CLINICAL TERM

Viral laryngotracheobronchitis (croup) is an infection of the subglottic larynx and trachea, most commonly caused by parainfluenza virus types 1, 2, or 3. The virus triggers mucosal inflammation and submucosal swelling (edema) in the subglottic region, which is the narrowest part of a child's airway. Because airway resistance increases to the fourth power as radius decreases (Poiseuille's law), even 1 mm of circumferential swelling significantly increases work of breathing and produces turbulent airflow, resulting in the characteristic biphasic a high-pitched noise on breathing in (stridor) (worse on inspiration) and barking cough.

How the body compensates

The child's body tries to keep oxygen levels normal by breathing faster and working harder. Early on, oxygen saturation and heart rate may look normal because the child is compensating. The danger is that this compensation hides how much trouble the child is in—until the child gets too tired to keep working that hard, and then breathing can fail quickly.

1. {'what': 'The child breathes faster (tachypnea) and uses extra muscles—neck muscles, muscles between the ribs, and belly muscles—to pull air in.', 'why': 'Working harder moves more air through the narrow space and keeps oxygen levels up for a while.'}
2. {'what': 'Heart rate goes up to pump oxygen around the body faster.', 'why': 'If each breath brings in less air, the heart compensates by beating faster to deliver what oxygen is available.'}

3. {'what': 'The child may sit upright and lean forward, drool, or refuse to lie down.', 'why': 'Sitting up uses gravity to help open the airway and makes it a little easier to breathe. (Note: drooling and refusing to lie flat are more typical of epiglottitis, a different and more dangerous condition—most children with croup can lie down and swallow normally.)'}
4. {'what': 'Oxygen saturation and color stay normal in mild to moderate croup.', 'why': 'Compensation is working—the child is moving enough air to keep oxygen levels up, so the pulse oximeter reads normal and the child does not look blue.'}
5. {'what': 'This stable appearance is the dangerous middle: the child looks okay because the body is working extremely hard, but you cannot see that effort in a single vital sign check.', 'why': 'If the team only checks numbers and the numbers look fine, they may miss that the child is on the edge of tiring out.'}
6. {'what': 'The crash point to watch for: a high-pitched noise on breathing in (stridor) at rest (when the child is calm and not crying), retractions that get worse, agitation or sleepiness, or oxygen saturation starting to drop.', 'why': 'These signs mean compensation is failing. The child is too tired to keep working this hard, and without help, breathing will stop.'}
7. {'what': 'Watch the trend, not just one moment. A child whose a high-pitched noise on breathing in (stridor) is getting louder, whose retractions are deeper, or who is getting more tired is getting worse—even if the oxygen number is still normal right now.', 'why': 'The body can only compensate for so long. Once the child tips over the edge, the window to help closes fast.'}

Domino effect

1. Virus (usually parainfluenza) enters the airway and infects the cells lining the subglottic space. — Parainfluenza virus accounts for about 75% of croup cases. The virus attaches to cells in the mucosa just below the voice box and starts to multiply.
2. The immune system detects the virus and sends white blood cells and fluid to the infected area, causing the tissue to swell. — This swelling (edema) is the body's normal response to infection—it is trying to wall off the virus and bring in cells to fight it. But in a narrow child's airway, that swelling takes up space the child needs to breathe.
3. The swollen tissue narrows the subglottic airway, and air moving through that tight space makes a harsh, barking cough and a high-pitched noise on the way in (inspiratory a high-pitched noise on breathing in (stridor)). — The barking sound comes from air vibrating the swollen vocal cords and tissue nearby. A high-pitched noise on breathing in (Stridor) is the sound of turbulent airflow through a narrow tube—like the whistle of wind through a crack.
4. Symptoms get worse at night. — When the child lies flat, gravity shifts fluid toward the head and neck, and the airway naturally narrows a little at night. Both of these things make the swelling feel tighter and the a high-pitched noise on breathing in (stridor) louder.

5. Symptoms get worse when the child cries or gets upset. — Crying increases heart rate and blood flow to the swollen tissue, which makes it swell even more. Crying also makes the child breathe faster and harder, pulling more air through the narrow space and making the a high-pitched noise on breathing in (stridor) louder.
6. Most children have mild croup: they cough and have a high-pitched noise on breathing in (stridor) only when upset or active, but they can play, eat, and drink normally. — In mild cases, the swelling is small enough that the child can still move enough air when calm. The body's compensation keeps oxygen levels normal without much extra work.
7. Some children have moderate to severe croup: a high-pitched noise on breathing in (stridor) at rest, visible chest retractions (skin pulling in between the ribs or at the neck with each breath), and trouble drinking or staying calm. — More swelling means a tighter airway. The child has to work much harder to breathe, and even at rest the airway is so narrow that every breath makes noise. This is when steroids and sometimes nebulized epinephrine are needed.
8. Steroids (usually a single dose of dexamethasone by mouth or injection) shrink the swelling and improve symptoms within a few hours. — Steroids calm the immune system's inflammatory response, which reduces fluid buildup and opens the airway. One dose lasts long enough (up to 72 hours) to cover the worst part of the illness while the body clears the virus.

Symptoms · what the patient feels, and why

- Barking cough (sounds like a seal): The airway below the vocal cords swells and narrows, so when air rushes through during a cough it makes a harsh, barky sound instead of a normal cough.
- A high-pitched noise on breathing in (Stridor) (high-pitched breathing sound when breathing in): The swollen airway is so narrow that air squeaks as it rushes past the tight spot—like blowing across a bottle opening—especially when the child breathes in deeply or gets upset.
- Hoarse voice or cry: The virus causes swelling around the vocal cords (the two bands of tissue that vibrate to make sound), so the voice sounds rough, scratchy, or weak.
- Runny nose and low fever (usually under 102°F): Croup is caused by a virus (usually parainfluenza) that first irritates the nose and throat lining, triggering mucus and a mild immune response that raises body temperature slightly.
- Chest wall retractions (skin pulls in between ribs or above collarbones when breathing): The narrow airway makes it harder to pull air in, so the child works much harder—the strong breathing muscles suck the soft skin inward with each breath.
- Restlessness or agitation: When a child is not getting enough oxygen because the airway is very tight, the brain senses the drop and the child becomes fussy, scared, or confused.

- A high-pitched noise on breathing in (Stridor) at rest (heard even when the child is calm and sitting still): If you hear the high-pitched squeaking sound even when the child is not crying or moving, it means the airway is so narrow that every normal breath squeezes past a very tight space—this signals more severe swelling.
- Drooling or difficulty swallowing: Croup usually does not cause drooling, so if the child is drooling it may mean something else is blocking the throat (like epiglottitis or a foreign object) and needs urgent attention.

Focused exam

- Seal-bark cough (sounds like a baby seal barking): This sound is the signature of croup. It tells you the voice box (larynx) and the tube just below it (subglottic area) are swollen from a virus, not from something else like epiglottitis (infected flap above the voice box) or a toy stuck in the airway.
- Hoarse or raspy voice: The vocal cords sit inside the voice box. When virus causes swelling, the cords can't vibrate smoothly, so the voice sounds rough or scratchy. This confirms the problem is in the voice box area.
- A high-pitched noise on breathing in (Stridor) on breathing in (high-pitched, noisy sound when air goes down the throat): A high-pitched noise on breathing in (Stridor) means the airway tube is narrowed. In croup, swelling below the voice box squeezes the air tunnel. You hear it loudest when the child breathes in because that's when the floppy, swollen walls get sucked inward even more.
- Symptoms get worse at night or when the child cries: When the child is calm and upright, the swollen airway stays more open. Crying increases air speed through the narrow tube, making noise louder and breathing harder. Lying flat at night lets fluid settle in the swollen tissue, making the blockage worse. This pattern confirms a swollen-tube problem.
- Mild fever (under 101°F or 38.3°C) or no fever, child still playing or alert: Croup is caused by a virus (usually parainfluenza), not a dangerous bacteria. The child looks uncomfortable but not severely ill. This helps you rule out epiglottitis or bacterial tracheitis, which make kids look very sick, drooling, and toxic.
- A high-pitched noise on breathing in (Stridor) even when sitting still and quiet, or chest pulling in hard with each breath (retractions): If you hear a high-pitched noise on breathing in (stridor) when the child is calm and at rest, the swelling is so bad that the airway is dangerously narrow all the time. The chest sucking in hard (retractions) means the child is working very hard to pull air through the tight space. This child needs hospital care and medicine right away.

Diagnostics · every test answers a question

- Clinical diagnosis (no tests needed in typical mild croup) → Does this child have the classic croup pattern (seal-bark cough, a high-pitched noise on breathing in (stridor), hoarse voice after a cold)?
- Pulse oximetry (oxygen saturation) → Is the child getting enough oxygen into the blood despite the narrowed airway?
- Anteroposterior (AP) neck X-ray (only if diagnosis is unclear) → Is there a 'steeple sign' (narrowing of the airway below the voice box that looks like a church steeple on the image)?
- Lateral neck X-ray (only if epiglottitis is suspected) → Is the epiglottis (the flap above the voice box) swollen and blocking the airway (looks like a thumb sign)?
- Respiratory viral panel (PCR or rapid antigen, rarely done) → Which virus is causing the croup (parainfluenza, RSV, influenza, adenovirus)?

Treatment logic

- Dexamethasone 0.6 mg/kg by mouth or IM injection (single dose, maximum 10 mg) → Steroid medicine shrinks the swollen tissue below the voice box (subglottic area), making the airway opening bigger so air flows easier. This reduces the noisy breathing (stridor) and seal-bark cough within 6 to 12 hours and keeps working for 24 to 48 hours.
- Nebulized racemic epinephrine (0.5 mL of 2.25% solution in 3 mL saline) for moderate-to-severe croup; watch the child for 3 to 4 hours afterward → Epinephrine shrinks the blood vessels in the swollen airway lining (like how a cold pack shrinks swelling on a bruise), making the airway opening bigger fast—within 10 to 30 minutes. A high-pitched noise on breathing in (Stridor) and breathing work improve quickly.
- Keep the child calm and comfortable in a caregiver's lap; avoid upsetting the child or doing unnecessary exams → Calm behavior keeps the child from crying hard, which would make them breathe faster and suck the swollen airway walls inward more, making a high-pitched noise on breathing in (stridor) and breathing worse. Staying calm keeps the airway as open as it can be.
- Cool mist from a humidifier or sitting in a steamy bathroom during episodes (traditional home remedy) → Moist air may soothe the dry, inflamed airway lining and might help loosen sticky mucus, making the cough a bit easier and the throat feel less scratchy.
- Send to the hospital if a high-pitched noise on breathing in (stridor) continues at rest after epinephrine wears off, oxygen level stays below 90 to 92%, or the child looks exhausted from breathing hard → Hospital means access to continuous monitoring, repeat epinephrine treatments, oxygen support, and emergency airway tools (intubation) if the swelling gets so bad the child can't breathe at all.

- Rule out epiglottitis, bacterial tracheitis, and foreign body (toy or food stuck in airway) by careful history and exam—do NOT force the child to lie down or stick a tongue blade in the throat if epiglottitis is possible → Confirms the problem is viral croup (subglottic swelling) and not a different emergency that needs different urgent treatment like antibiotics (for bacterial infection) or bronchoscopy (to remove a stuck object).

Medications

Dexamethasone · Corticosteroid (a drug that calms down swelling and the immune response)

Dexamethasone shrinks the swelling in the voice box area by stopping certain immune cells from releasing chemicals that make tissue puff up. It works like turning down the volume on your body's alarm system so the airway opens up again.

1. The virus (usually parainfluenza) infects the cells lining the airway below the voice box.
2. Your immune system sends white blood cells and chemicals to fight the virus, but this causes swelling.
3. Dexamethasone enters cells and tells them to stop making proteins that cause swelling.
4. Within a few hours, the swelling starts to go down and the airway opens wider.
5. Breathing becomes easier, the barking cough gets quieter, and a high-pitched noise on breathing in (stridor) (the squeaky sound when breathing in) improves.

SAFETY WATCH

One dose is very safe; serious side effects are extremely rare. · A child might be more energetic or have trouble sleeping for a day or two. · Do NOT withhold dexamethasone because of worry about side effects—the benefit is huge and the risks are tiny for a single dose. · Safe to give even if the child has had steroids recently or has diabetes (one dose will not cause long-term harm).

Racemic epinephrine (nebulized) · Sympathomimetic bronchodilator (a drug that tightens blood vessels and relaxes airway muscles)

Racemic epinephrine squeezes the tiny blood vessels in the swollen airway lining, pushing fluid back out of the tissue. It is like wringing water out of a sponge—the airway shrinks and opens up fast.

1. The medicine is breathed in as a mist through a nebulizer mask.
2. Epinephrine lands on the swollen airway tissue and binds to alpha receptors on blood vessel walls.
3. The blood vessels squeeze tight (vasoconstriction), pushing extra fluid out of the tissue.

4. The airway lining shrinks quickly—usually within 10 to 30 minutes.
5. Breathing becomes easier and a high-pitched noise on breathing in (stridor) goes away or gets much quieter.
6. The effect wears off in about 2 hours, so the swelling can come back (rebound). This is why we watch the child for 3 to 4 hours after the treatment.

SAFETY WATCH

The child must be watched for at least 3 to 4 hours after the dose because the effect wears off and swelling can come back. · Heart rate may go up a little; this is normal and not dangerous in most children. · If a high-pitched noise on breathing in (stridor) returns at rest after epinephrine wears off, the child needs hospital admission. · Safe to give more than once if needed, but repeated doses mean the child is sick enough to stay in the hospital.

Red flags

- A high-pitched noise on breathing in (Stridor) at rest (high-pitched sound even when the child is calm)
- Severe chest retractions or the child looks like they are working very hard to breathe
- Blue or pale lips or skin (sign of low oxygen)
- Drooling or unable to swallow (suggests a more dangerous throat blockage)
- The child is very sleepy, limp, or hard to wake up

Nursing priorities

1. Keep the child calm and sitting upright in the caregiver's lap; do not lay the child flat or do upsetting exams — Agitation and crying make the child breathe faster and harder, which increases turbulent airflow (rough air movement) through the already swollen airway and worsens a high-pitched noise on breathing in (stridor) and obstruction
2. Watch for a high-pitched noise on breathing in (stridor) at rest, severe retractions, bluish skin (cyanosis), or altered mental status every 15 minutes and notify the provider immediately if any appear — These signs mean critical airway narrowing or low oxygen (hypoxia); the child may need emergency intubation (a breathing tube placed in the windpipe) or epinephrine within minutes to prevent respiratory arrest
3. Administer dexamethasone 0.6 mg/kg by mouth or intramuscular injection as ordered (maximum 10 mg single dose) — Dexamethasone is a corticosteroid (anti-swelling medicine) that reduces airway swelling (edema) (swelling); it works within 30 minutes to 6 hours and decreases the need for hospitalization and return visits

4. Give nebulized racemic epinephrine (0.5 mL of 2.25% solution in 3 mL saline) for moderate or severe a high-pitched noise on breathing in (stridor) and watch the child for at least 3 to 4 hours afterward — Epinephrine causes vasoconstriction (blood vessel tightening) in the airway lining, which quickly reduces swelling (edema) and improves breathing; but the effect wears off in 2 hours and rebound swelling can happen
5. Avoid placing anything in the child's mouth or throat, including tongue blades or thermometers — Stimulating the pharynx (back of the throat) can trigger laryngospasm (sudden airway muscle tightening) and complete airway obstruction in a child with a swollen, irritable airway
6. Keep emergency airway equipment at the bedside, including bag-valve mask, oxygen, suction, and intubation supplies sized for the child — Croup can progress rapidly to complete airway obstruction; having the right-sized equipment ready ensures the team can ventilate (push air into the lungs) or intubate quickly if the child stops breathing
7. Offer cool mist from a humidifier or let the caregiver sit with the child in a steamy bathroom for comfort — Mist may soothe the inflamed airway mucosa (lining) and thin secretions, though evidence for effectiveness is limited; it helps keep the child and caregiver calm, which prevents worsening obstruction
8. Reassess the croup score (respiratory rate, retractions, a high-pitched noise on breathing in (stridor), air entry, and bluish skin (cyanosis)) and document every 1 to 2 hours after treatment — Objective scoring like the Westley croup score tracks response to steroids and epinephrine, guides decisions about safe discharge versus admission, and detects deterioration early

Sources

- AAP Clinical Practice Guideline (American Academy of Pediatrics)
- Cochrane systematic review on croup
- CDC (parainfluenza and viral croup)
- UpToDate clinical summary on croup

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