

Croup Clinical Care Guideline

Majid Keivanfar M.D
Pediatric Pulmonologist
Isfahan University Of Medical Sciences

- ✓ Acute inflammatory process
- ✓ Expressed as laryngotracheitis
- ✓ Begins in the nasopharynx
- ✓ Epithelium of larynx & trachea
- ✓ Inflammation, and edema of the vocal folds

Stridor

- ✓ rapid, turbulent flow of air through a narrowed segment of a large airway.
- ✓ It is most often loud, with medium or low pitch, and inspiratory.
- ✓ It usually originates from the larynx, upper trachea, or hypopharynx.
- ✓ Progression of the disease process may make stridor softer, higher-pitched, and biphasic (inspiratory and expiratory).

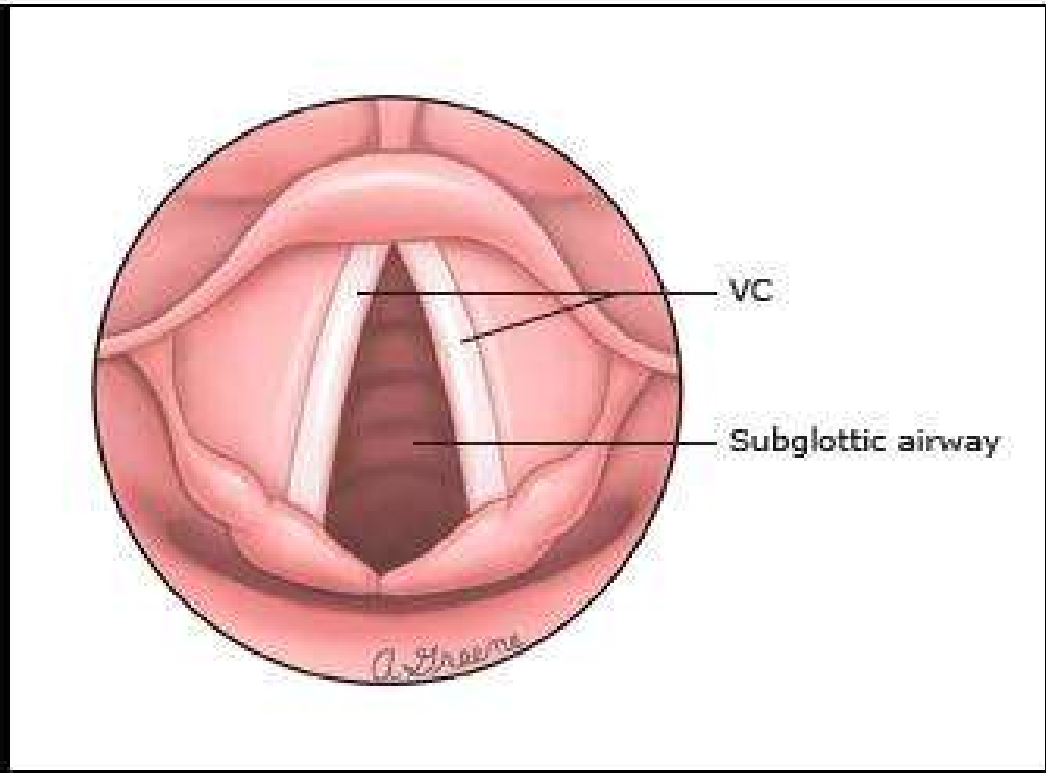
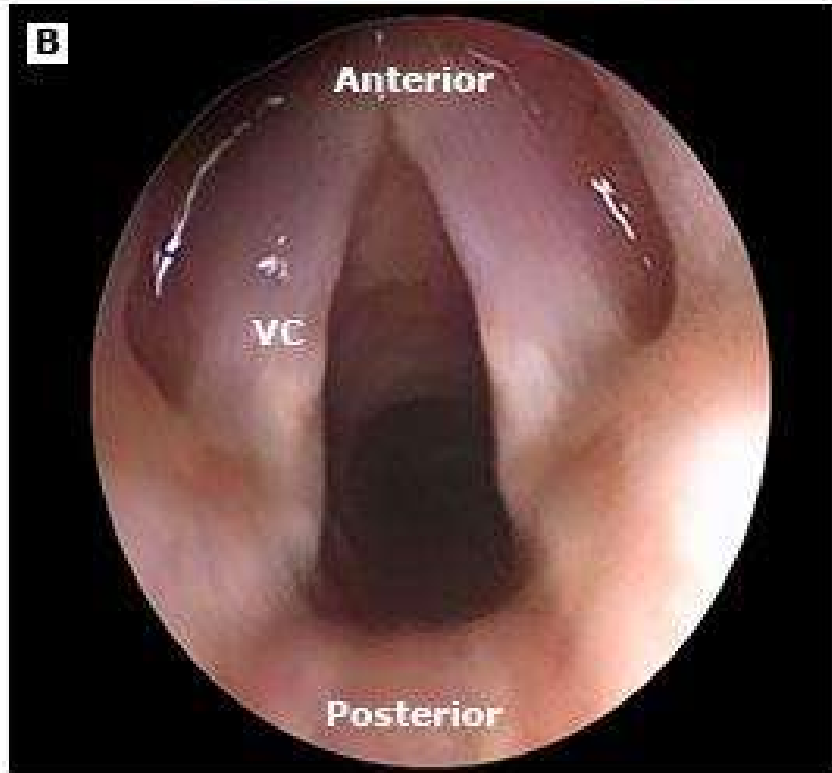
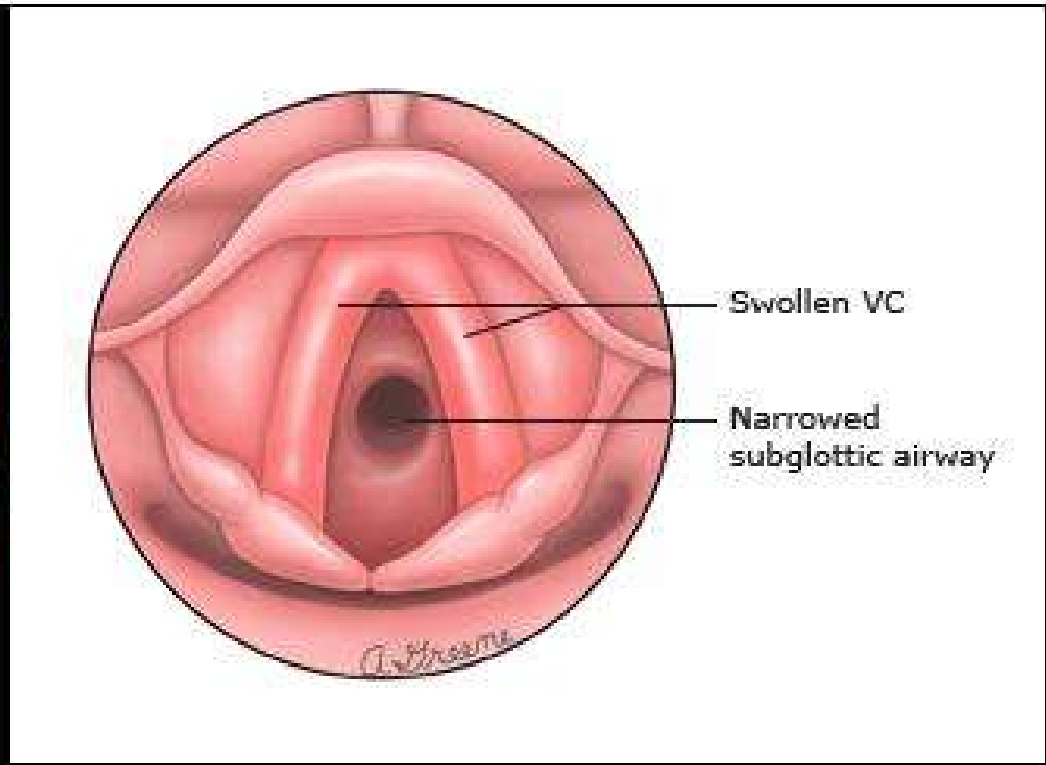
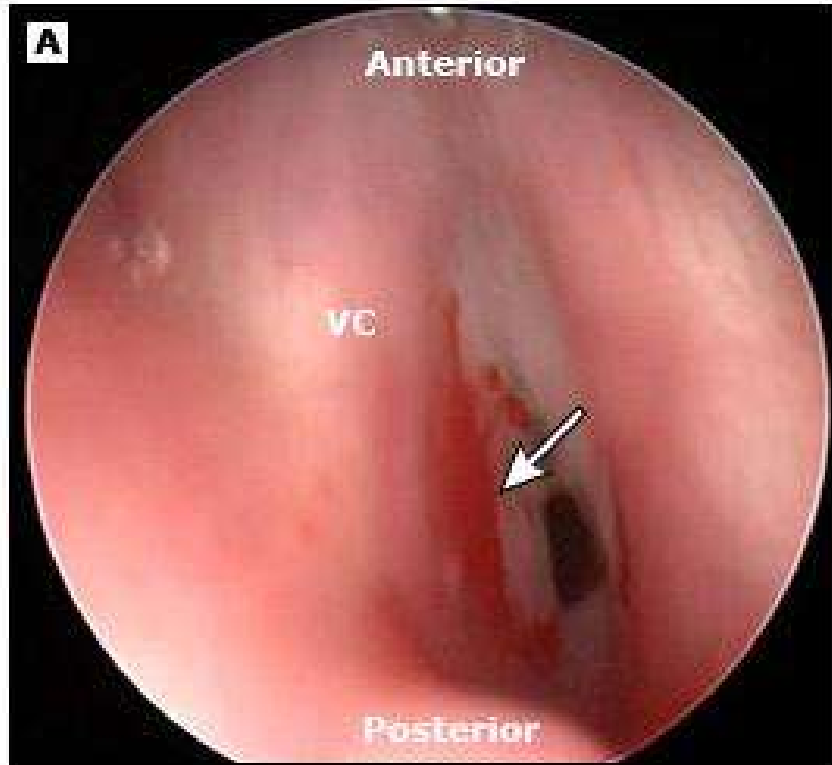
The laryngeal anatomy of children makes them particularly susceptible to narrowing of the upper airways.

The larynx of a neonate is situated high in the neck, and the epiglottis is narrow, omega-shaped, and vertically positioned.

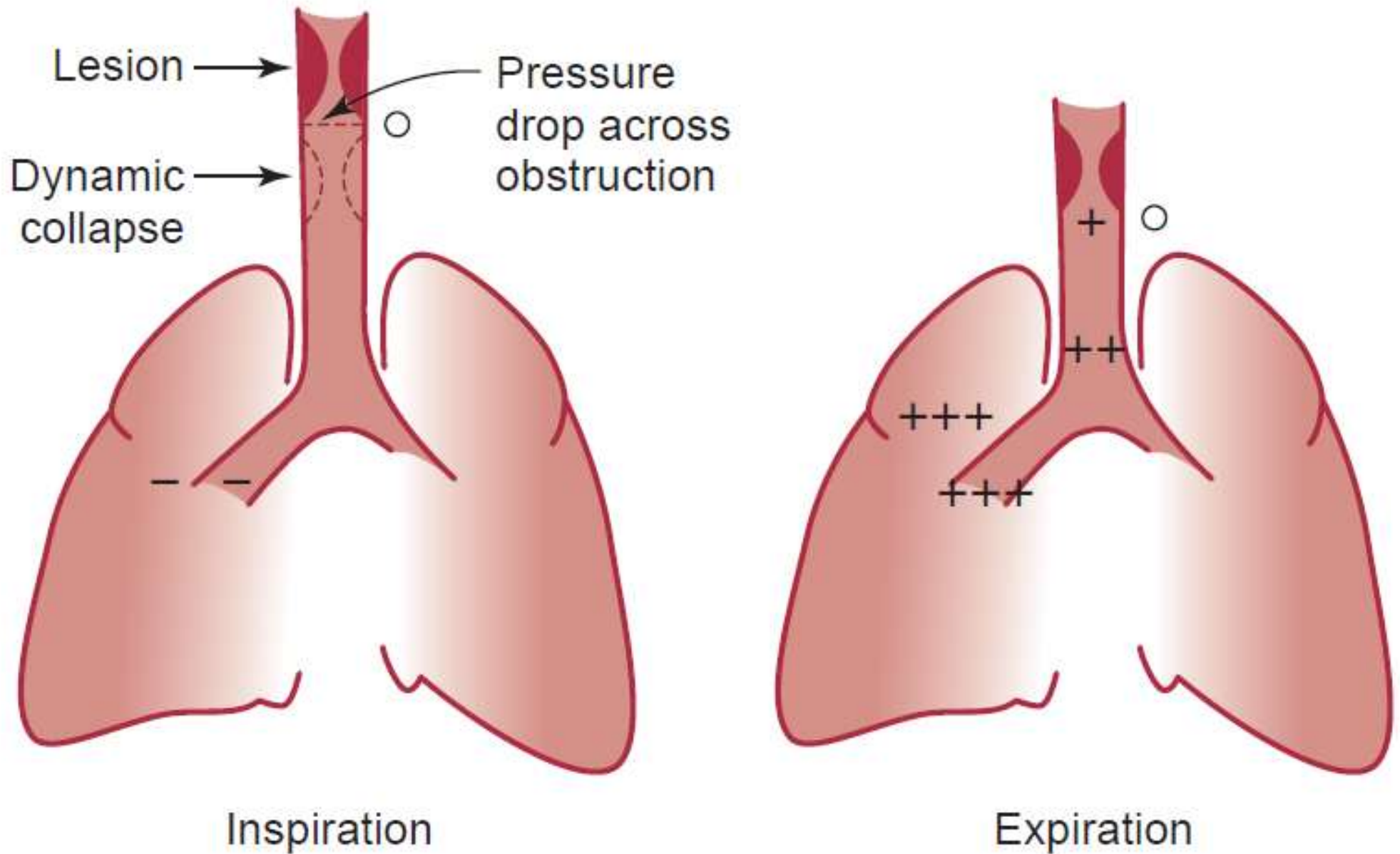
The narrowest segment
of the pediatric airway is the
subglottic region

- encircled by the rigid cricoid cartilage ring.
- There is nonfibrous, loosely attached mucosa

The diameter of the sub-glottis in a normal newborn is approximately 5 mm, and 1.5-mm edema in this region reduces the cross-sectional area to 64% of normal (area = $\pi \times \text{radius}^2$). Air flow is directly proportional to the airway radius to the fourth power (**Poiseuille's law**), so a small reduction in caliber has a major effect on flow rate. The same 5-mm airway with 1.5 mm edema will have a **flow rate of only 41%** of baseline, assuming that pressure remains unchanged—a situation that is not necessarily the case if the **Bernoulli** principle is in play.



EXTRATHORACIC OBSTRUCTION



Etiology of Croup (Laryngotracheitis)

Parainfluenza type 1 (most common) 2, 3

Influenza A & B

Human metapneumovirus (hMPV)

Measles virus

Respiratory syncytial virus (RSV)

Adenovirus

Rhinovirus

Mycoplasma pneumoniae

Enteroviruses

Herpes Simplex viruses

ReoViruses

Severity does not correlate with any particular etiologic agent.

Herpesviruses tend to cause a more severe and protracted form of the disease.

However, children hospitalized with influenzal croup tend to have longer hospitalization and greater risk of readmission for relapse of laryngeal symptoms.

Polymorphonuclear and monocytic leukocytes infiltrate the sub-epithelium

Vascular congestion and **airway wall edema**.

Spasmogenic mediators, decreased airway diameter.

This may result from a **type I hypersensitivity** response to PIV, and some authors have postulated a role for **anti-PIV-specific (IgE)** in the development of airway narrowing.

Host factors

Only a small fraction of children with a parainfluenza viral infection develop overt croup.

- Congenital anatomic airway narrowing
- Hyperactive airways
- Acquired airway narrowing
- Parainfluenza virus-specific (IgE)
- Increased lymphoproliferative response

Age: 6 months to 3 yrs (Mean = 18 mos)

Duration: 3 to 5 days, symptoms maximal day 2 to 3

Epidemiology: Year round; most common **fall**

Uncommon in children >6 years old

Male:female ratio 1,4:1

Clinical Progress

Day 1 to 3

Rhinorrhea

Sore throat

Low grade fever

Mild cough

Day 3 to 5

Onset symptoms of upper airway inflammation

Hoarseness

Barking cough

Stridor (variable)

Respiratory distress (variable)

History

- **Fever** – The absence of fever is suggestive of spasmodic croup or other noninfectious etiology
- **Barking cough** – The classic physical finding
- **Hoarseness** – Hoarseness may be present in croup
- **Difficulty swallowing** – acute epiglottitis. ingested foreign body in upper esophagus
- **Drooling** – peritonsillar or retropharyngeal abscesses, retropharyngeal cellulitis, and epiglottitis.
- **Throat pain** – more common in epiglottitis

Family history of croup is a risk factor for croup and recurrent croup.

3,2 times have an episode of croup
4,1 times to have recurrent croup.

Parental smoking, does not appear to increase the risk of croup !!

Emergency department visits for croup are most frequent between 1:00 PM and 4:00 AM.

However, children seen for croup between noon and 6:00 PM are more likely to be admitted to the hospital.

- temperatures may reach $39-40^{\circ}\text{C}$
- some children are afebrile

Croup is a disease of the upper airway, and alveolar gas exchange is usually normal.

Hypoxia and low oxygen saturation are seen only when complete airway obstruction is imminent.

The child who is hypoxic, cyanotic, pale, or obtunded needs immediate airway management.



Factors that are associated with increased severity of illness include:

- Sudden onset of symptoms
- Rapidly progressing symptoms (ie, symptoms of upper airway obstruction after fewer than 12 hours of illness)
- Previous episodes of croup
- Underlying abnormality of the upper airway
- Medical conditions that predispose to respiratory failure (eg, neuromuscular disorders)

Differential Diagnosis

Allergic reaction

Bacterial tracheitis

Epiglottitis

Foreign body aspiration

Hemangioma (subglottic)

Infectious mononucleosis

Laryngeal diphtheria

Laryngeal nerve compression

Paraquat poisoning

Peritonsillar abscess

Retropharyngeal abscess

Subglottic stenosis

Trauma

Tumor \ intracranial process (rare)

Spasmodic croup

- Allergic response to viral antigen
- Acute non-inflammatory swelling
- Acute nocturnal onset
- Older child
- Repeat attacks
- Do not have coryzal prodrome
- Afebrile
- Links with atopy
- Positive family history

Treatment is similar to that for viral LTB.

Some practitioners prescribe oral or inhaled corticosteroids to be kept at home and administered by the parents in case of an episode.

The etiology of recurrent, spasmodic croup remains unclear, suggested triggers include:

- Gastro esophageal reflux
- Anatomical abnormalities
- Allergic predisposition
- EOE

Additional studies

- Plain lateral neck and
- Chest radiographs
- Computed tomography
- Barium swallow and a pH study
- Polysomnography

Rarer causes of recurrent stridor
(e.g., **hypocalcaemia** or **angioneurotic edema**)
are diagnosed by blood testing.

• **Other potential mimickers of croup**

Bronchogenic cyst (which can cause airway compression)

Guillain-Barré syndrome (involvement of the laryngeal nerve may cause vocal cord paralysis)

Laboratory and Radiology Studies

Diagnostic tests are only indicated if they will change outcome. **Croup is a clinical diagnosis** and usually no testing needed.

a posterior-anterior chest radiograph demonstrates subglottic narrowing, commonly called the "steeple sign" .

The lateral view may demonstrate overdistention of the hypopharynx during inspiration and subglottic haziness.

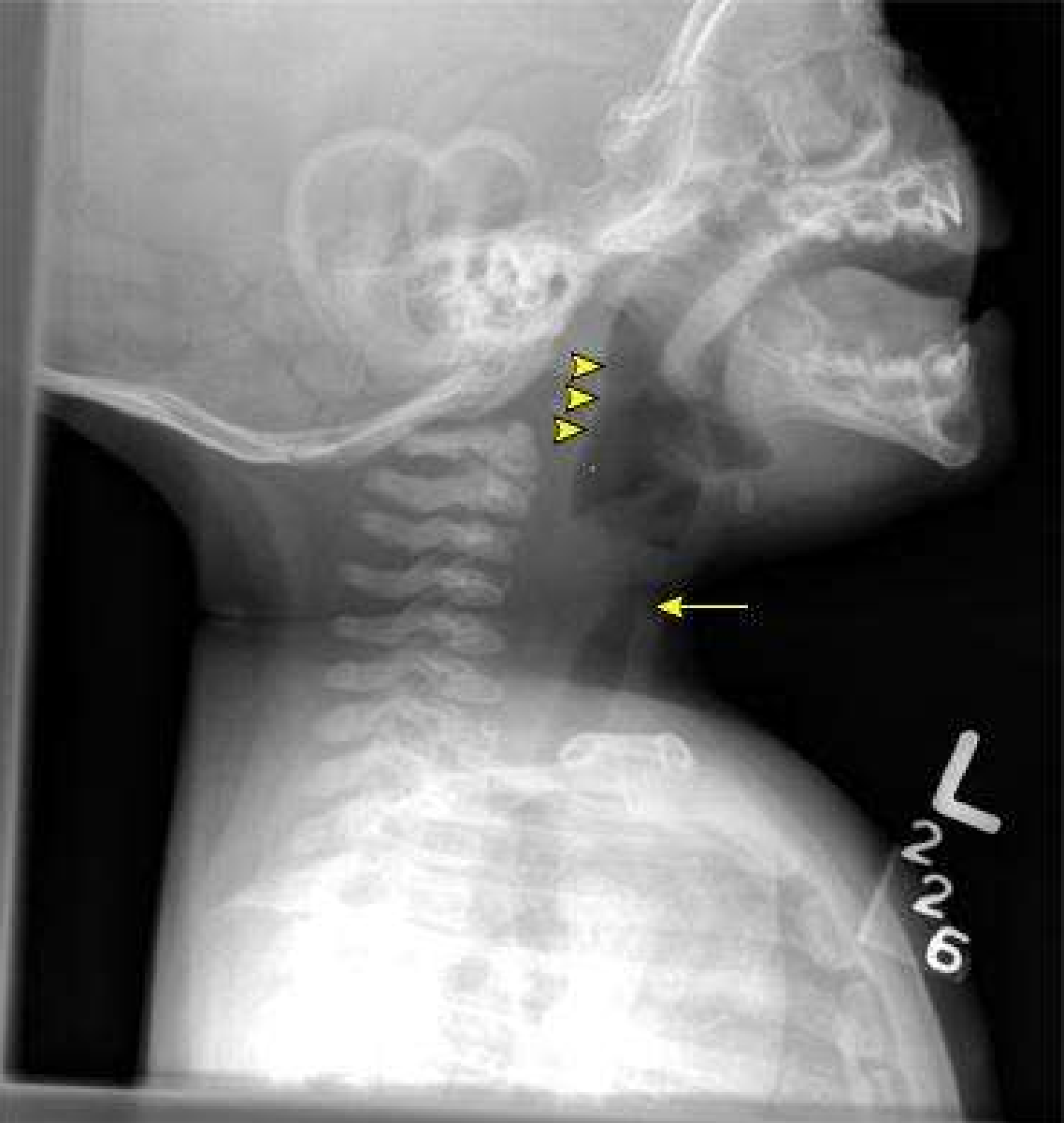
“steeple sign”

- may be absent in patients with croup,
- may be present as a normal variant,
- may occasionally be present in epiglottitis

Plain Lateral Neck View

- Rarely influences management
- Wastes time
- **Can be dangerous**
- **The neck extension can be fatal**

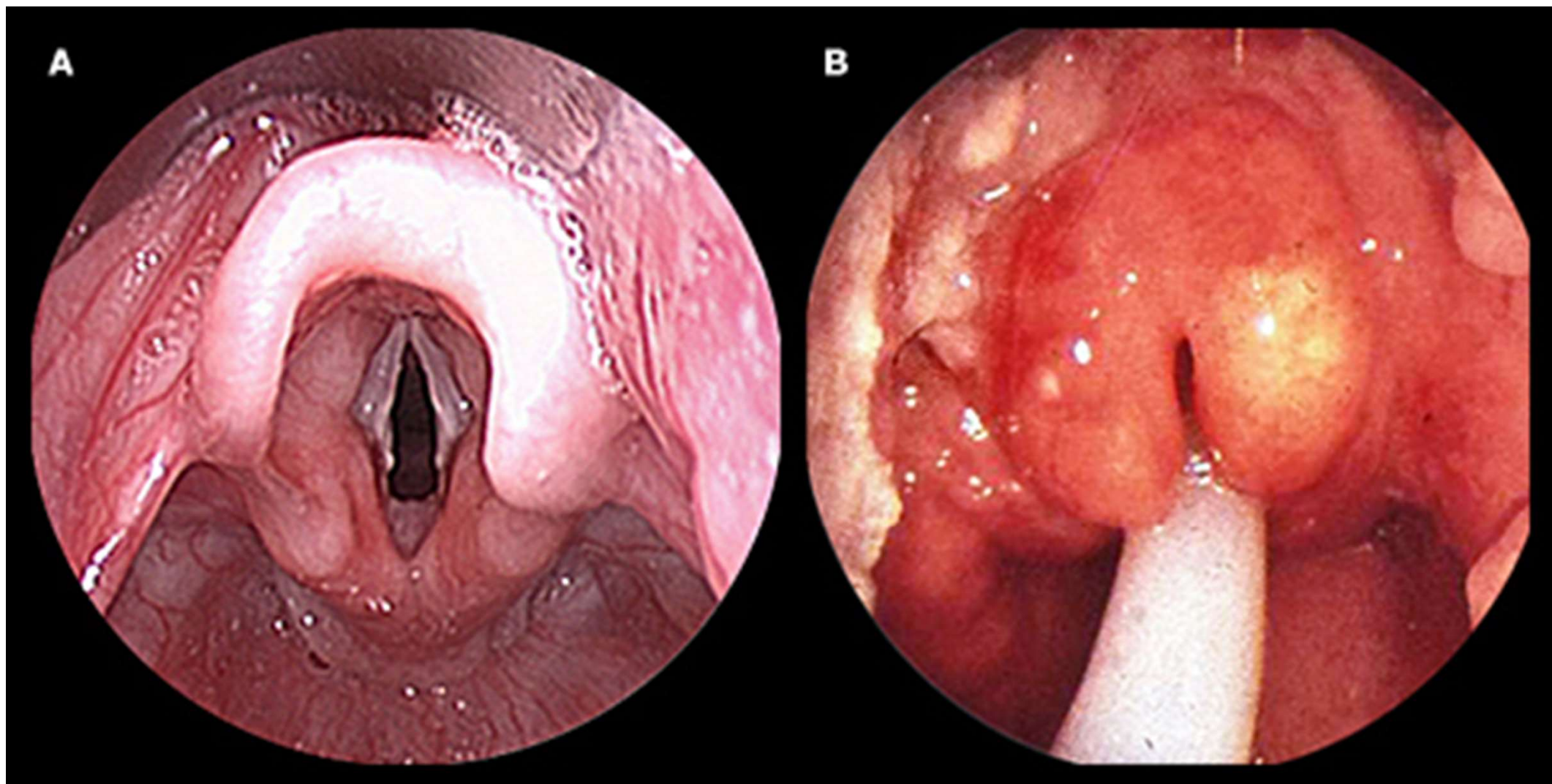






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Monitoring

- Oxygen saturation (SaO_2) usually normal in croup unless tracheitis present
- Continuous cardiac/pulse oximetry monitoring only recommended for unstable patient or receiving repeat nebulized epinephrine
- Follow vital signs to assess response to therapy: temperature, heart rate, respiratory rate

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SWIM BARRED



Therapeutics

Home treatment

In acute situations and for short periods of time, caregivers may try **sitting with the child in a bathroom** filled with steam generated by **running hot water** from the shower to improve symptoms. **This may help reassure parents that "something" is being done** to reverse the symptoms, and anecdotal evidence supports some benefit with this measure.

Corticosteroids

Dosing: Single Dose

Mechanism of action: Long lasting anti-inflammatory agent
Decrease edema in laryngeal mucosa

Adverse Effects:

Risk of progressive viral infection

Risk of secondary bacterial infection

Exacerbate active varicella or TB

Mask steroid dependant upper airway lesions (hemangioma)

- **Dexamethasone**

Dose: 0.15 to 0.6 mg/kg orally (preferred), IV, IM

Frequency: Once

Maximum Dose: 16 mg

Peak serum levels:

Oral: Within 1 to 2 h

IM: within 1 h

Duration of action: 24 to 72 h

- **Nebulized Budesonide 2mg [C]**

Equal efficacy to dexamethasone; expensive

Consider in children with emesis or severe respiratory distress

- **Prednisolone [C]**

Dose: 1 mg/kg

- **Prednisone [C]**

Dose:

4 mg/kg/ (equivalent 0.6 mg/kg dexamethasone)

2 mg/kg/ (equivalent 0.3 mg/kg dexamethasone)

1 mg/kg/ (equivalent 0.15 mg/kg dexamethasone)

Repeated corticosteroid dosing

Are not necessary on a routine basis.

Moderate to severe symptoms that persist for more than a few days should prompt investigation for other causes of airway obstruction.

Nebulized Epinephrine

Mechanism of Action: Stimulation α -adrenergic receptors
Constrict capillary arterioles causing fluid resorption from
interstitial space and decreases interstitial edema

Duration of action: less than or equal to 2 hours

Efficacy: Racemic & L-epinephrine are equally efficacious

Adverse effects: Myocardial Infarction (rare)

• Racemic Epinephrine

(1:1 mixture of δ & θ -isomers epinephrine)

Dose: 0.5 mL/kg/dose of 2.25% solution in 2.5 mL normal saline (NS) via nebulizer over 15 minutes

Weight less than 5 kg = 0.25 mL

Weight greater than or equal to 5 kg = 0.5 mL

Frequency: Repeat every 20 min as indicated

Maximum Dose: 0.5 mL

• L-epinephrine

Dose:

• 0.5 mL/kg/dose of 1:1000 L-epinephrine in 2.5 mL of NS via nebulizer over 15 min

Frequency:

Repeat every 15 to 20 minutes as indicated

Maximum Dose:

5 mL

The term 'rebound phenomenon' is a misnomer.
Epinephrine doesn't change the duration of
croup and benefits lasts less than or equal
to 2 hours.

It is safe to send children home from the ED after receiving racemic epinephrine if they have been observed for a minimum of 3 hours post therapy .

Other therapies

- **Mist:** Humidified air with or without oxygen
[C]

Controversial therapy **without supporting evidence**

May moisten airway secretions

May decrease airway inflammation

May decrease viscosity of tracheal mucus secretions enabling patient to remove them by coughing

May increase wheezing in laryngotracheitis-bronchitis \ pneumonitis

Mist therapy may provide a sense of comfort and reassurance to both the child and family.

- Anti-tussive or decongestant [C]

- Antibiotics [A]

No role in uncomplicated croup

Indicated only for bacterial component (tracheitis)

- Helium-Oxygen Mixture [B]

Not shown to be more effective than nebulized epinephrine

May be efficacious in patient with severe croup with impending respiratory failure.

**CROUP SCORE
(Modified Westley)**

Indicators of Disease Severity	Score
Inspiratory stridor	
None	0
Only with agitation or activity	1
At rest	2
Intercostal Retractions	
None	0
Mild	1
Moderate	2
Severe	3
Air Entry	
Normal	0
Mildly decreased	1
Severely decreased	2
Cyanosis	
None	0
With agitation \ activity	4
At rest	5
Level of Consciousness	
Normal	0
Altered	5

Severity assessment

- **Mild croup (croup score of ≤ 2)**

no stridor at rest

- **Moderate croup (croup score of 3 to 4)**

stridor at rest

- **Severe croup (croup score of ≥ 5)**

significant stridor at rest,

Impending respiratory failure (Westley croup score of ≥ 12) :

- Fatigue and listlessness
- Marked retractions
- Decreased or absent breath sounds
- Depressed level of consciousness
- Tachycardia out of proportion to fever
- Cyanosis or pallor

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Parent Guide



Calculate by QxMD

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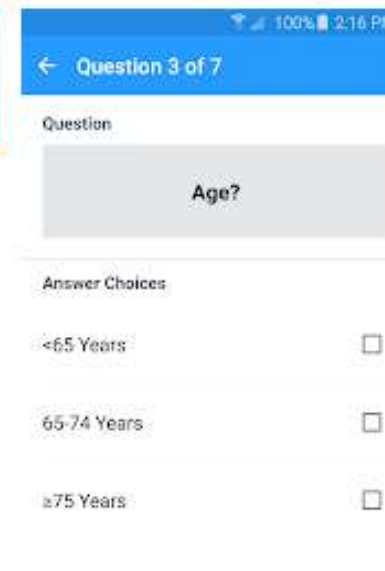
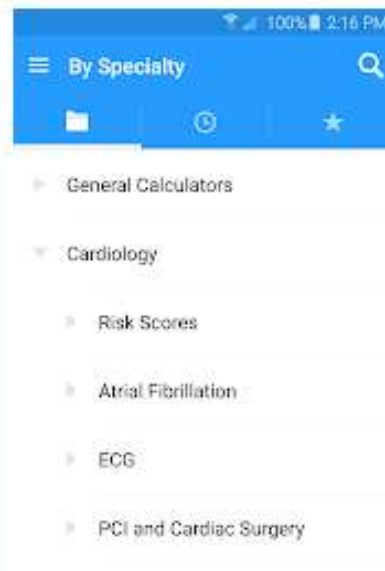
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Contains Ads

This app is compatible with all of your devices.

Installed



- Mild croup (croup score of ≤ 2)
no stridor at rest

Home treatment:

Symptomatic care including antipyretics, mist, and oral fluids

Outpatient treatment:

Single dose of oral dexamethasone

to 0.6 mg/kg (maximum 16 mg)*

0.15

- Moderate croup (score of 3 to 5) should be evaluated in the emergency department or office

Single dose of oral dexamethasone

0.6 mg/kg (maximum 16 mg)*

Nebulized epinephrine

Hospitalization is generally not needed

Observe for 3 hrs . Discharge if indicated.

• **Severe croup (score of ≥ 7)**

significant stridor at rest,
should be evaluated in the **emergency department**

Single dose of oral/IM/IV dexamethasone

0.6 mg/kg (maximum 16 mg)*

Repeated doses of nebulized epinephrine may
be needed

Inpatient admission is generally required

Score < 7 ? Observe for 3 hrs

Score > 7 ? Repeat epinephrine >>PICU

Hospital admission

Patients with **ongoing severe symptoms after initial treatment** should receive additional nebulized epinephrine and should be admitted to the hospital.

Nebulized epinephrine can be repeated **every 15 to 20 minutes**. The administration of **three or more doses** within a two- to three-hour time period should prompt initiation of close **cardiac monitoring** if this is not already underway.

Admit ICU

- Consider for croup score greater than 4
- Escalating stridor at rest despite therapy
- Patient benefiting from ICU monitoring, treatment, or environment
- Any patient with impending respiratory failure:
 - SaO₂ less than 90% in 40% FiO₂
 - Cyanosis with supplemental oxygen

Oxygen should be administered to **any child** with **severe airway obstruction**, even in the absence of severe hypoxia, because it will **aid respiratory muscle** function.

Some children with severe croup either do not respond to the usual therapies or are too severely compromised at presentation to permit their use. These children require **urgent endotracheal intubation** and mechanical ventilation to avoid potentially catastrophic complete airway obstruction and the serious sequelae of hypoxia and hypercapnia .

Intubation should be performed by **the most experienced person available**, and it should be attempted with an uncuffed endotracheal tube **one size smaller** than the usual size for the child. Facilities for **immediate tracheostomy** must be available at the time of intubation

Most children without severe parenchymal involvement require respiratory support for 3 to 5 days. This is one context in which multiple rather than single doses of corticosteroids are often administered. The timing of extubation will depend on the development of an air leak, indicating resolution of airway narrowing. Re-intubation rates of approximately 1.5% have been reported.

Discharge Home

- Vital signs baseline
- Normal pulse oximetry
- Tolerating fluids by mouth
- No stridor at rest
- Good air exchange
- Normal color
- Caregivers understand instructions

Who Should Be Evaluated?

- multiple episodes
- severe or frequent
- slow to resolve
- absence of obvious infections

seven days?

- **Underlying airway abnormality**
- **Complication of croup**

PROGNOSIS

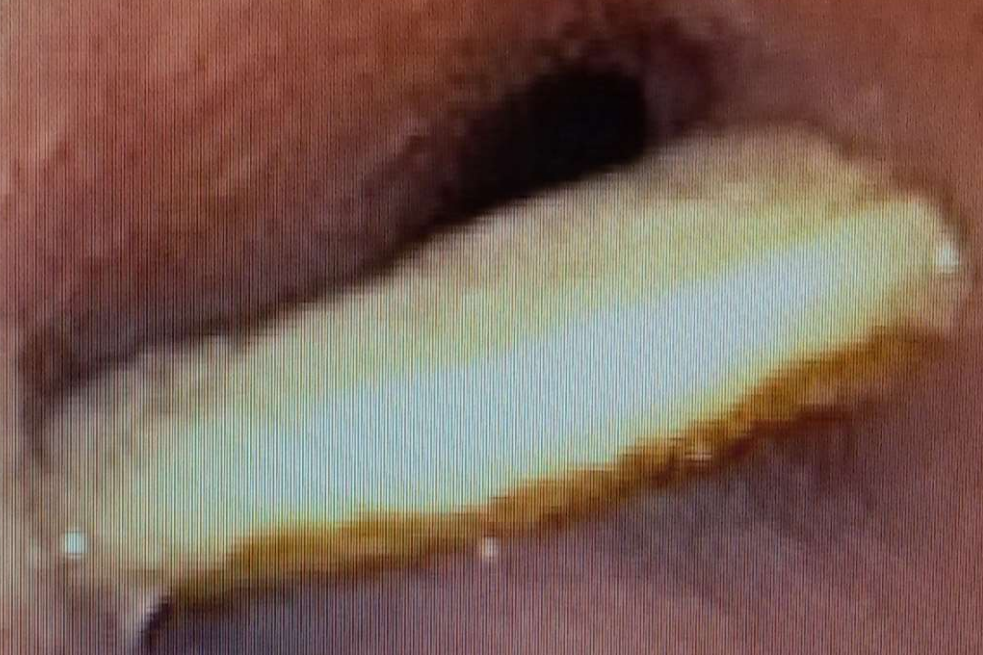
Symptoms of croup resolve in most children within three days but may persist for up to one week .

Approximately 8 to 15 percent of children with croup require hospital admission and among those, 2 percent require intubation . Mortality is rare, occurring in 1 percent of intubated children

Investigation is usually centered on
airway endoscopy.

This must be performed in a unit and by an operator who is experienced in the technique because there is a risk in many of these conditions of exacerbating the airway obstruction.

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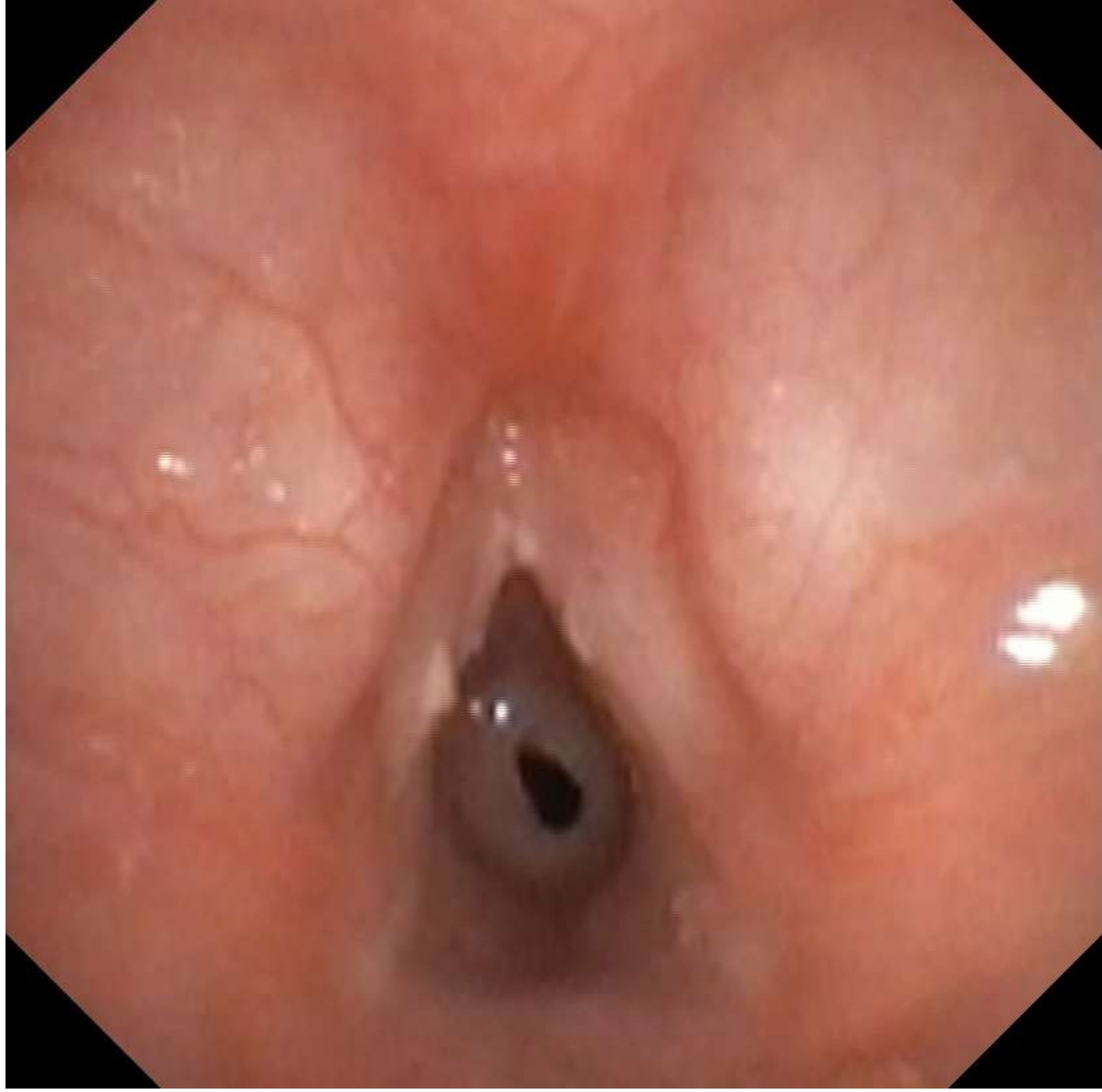






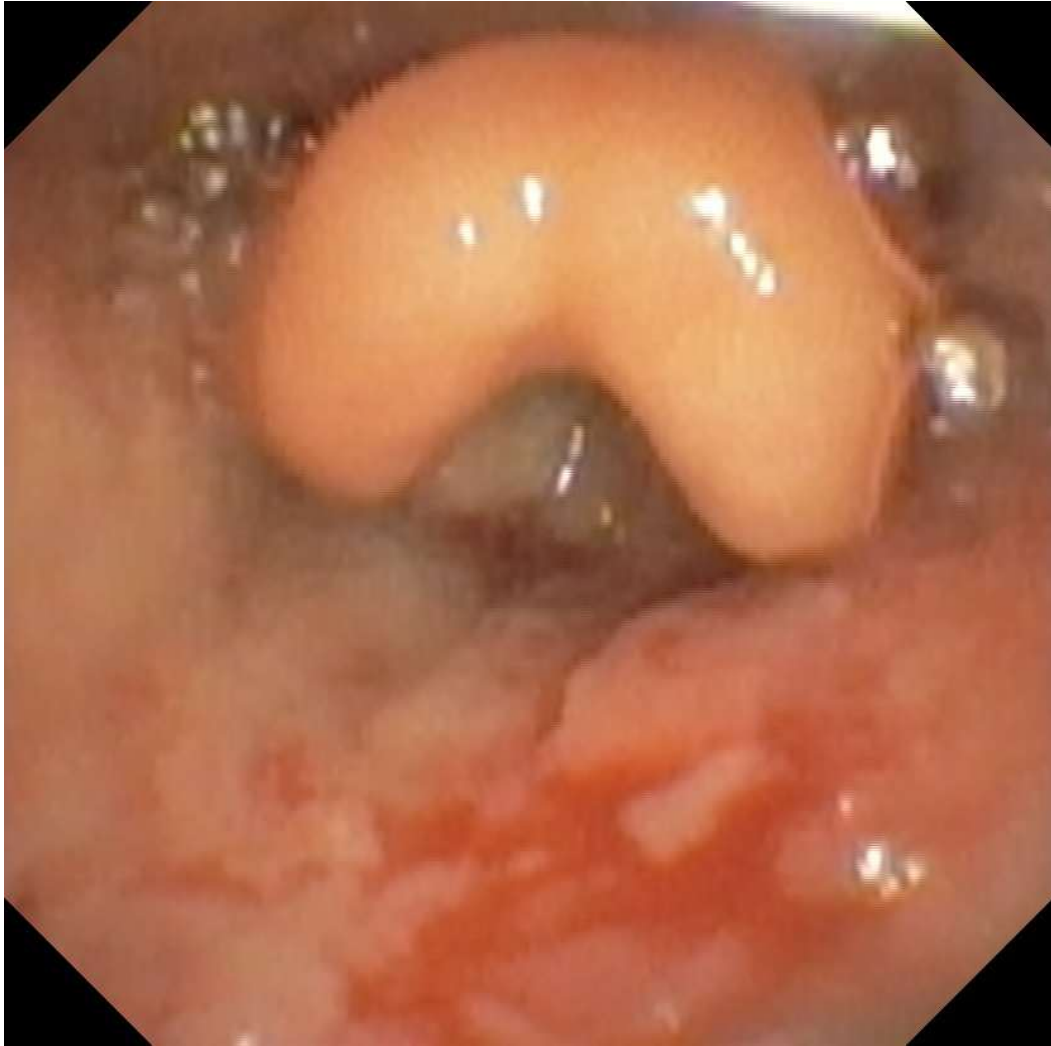
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Acute Epiglottitis

Majid Keivanfar M.D
Pediatric Pulmonologist
Isfahan University Of Medical Sciences

Etiology:

- Haemophilus influenzae type B (Hib)
- H. influenzae types A and F, and nontypeable strains
- Haemophilus parainfluenzae
- Streptococcus pneumoniae
- Staphylococcus aureus
- Beta-hemolytic streptococci: Groups A, B, C, F, G
- Pasteurella multocida
- Moraxella catarrhalis
- Klebsiella pneumoniae
- Neisseria meningitidis and other Neisseria species
- Escherichia coli
- Enterobacter cloacae
- Pseudomonas aeruginosa

Etiology:

Viral causes

- Herpes simplex virus type 1
- Varicella zoster virus
- Parainfluenza virus type 3
- Influenza B viruses
- Epstein-Barr virus

Fungal causes

- Candida albicans*

NonVaccinated:

The **typical patient** was **2-4 yr** of age, although cases were seen in the 1st year of life and in patients as old as **7 yr** of age.

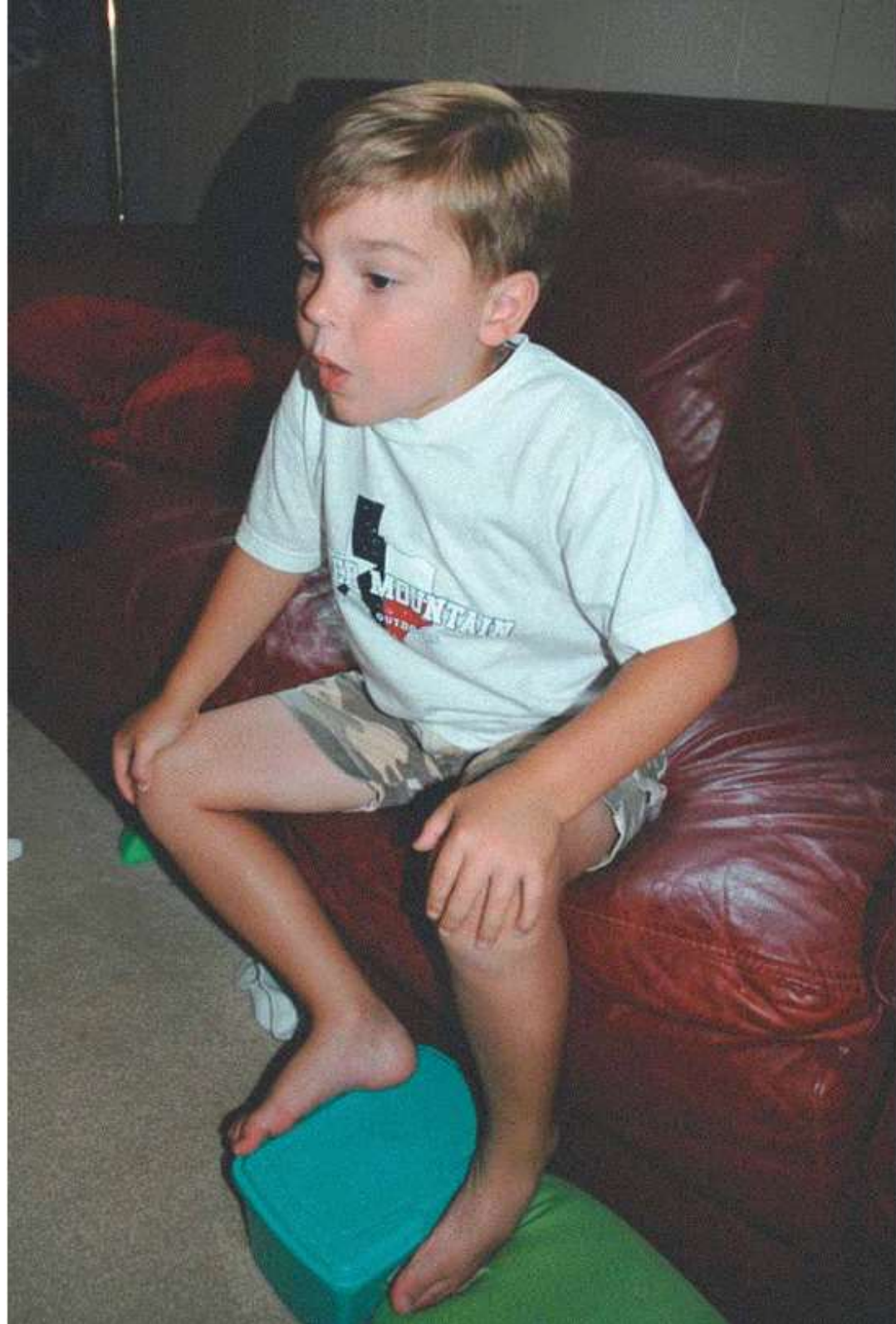
Vaccinated:

The typical patient with epiglottitis is an **adult** with a sore throat.

acute fulminating course of
high fever, sore throat, dyspnea,
and
rapidly progressing respiratory
obstruction.

Within a matter of hours,
the patient appears **toxic**,
swallowing is difficult, and
breathing is labored.

Drooling is usually present and the
neck is hyperextended
in an attempt to maintain the airway.





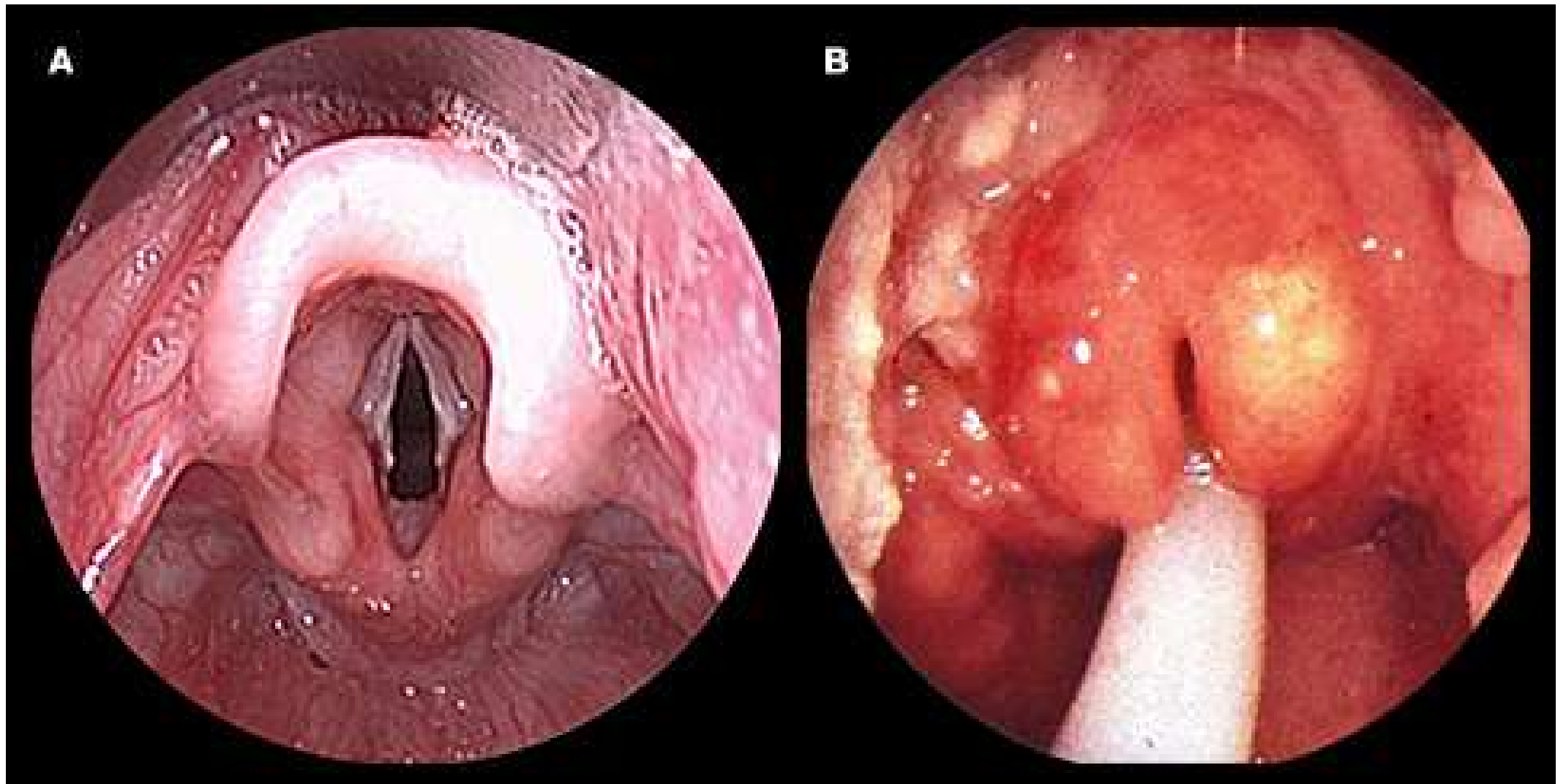
**Stridor is a late finding
and suggests
near-complete airway obstruction.**

The **barking cough**
typical of croup is **rare**.

Usually, no other family members are
ill with acute respiratory symptoms.

The diagnosis:

visualization of a large, "cherry red"
swollen epiglottis by laryngoscopy.



EPIGLOTITIS

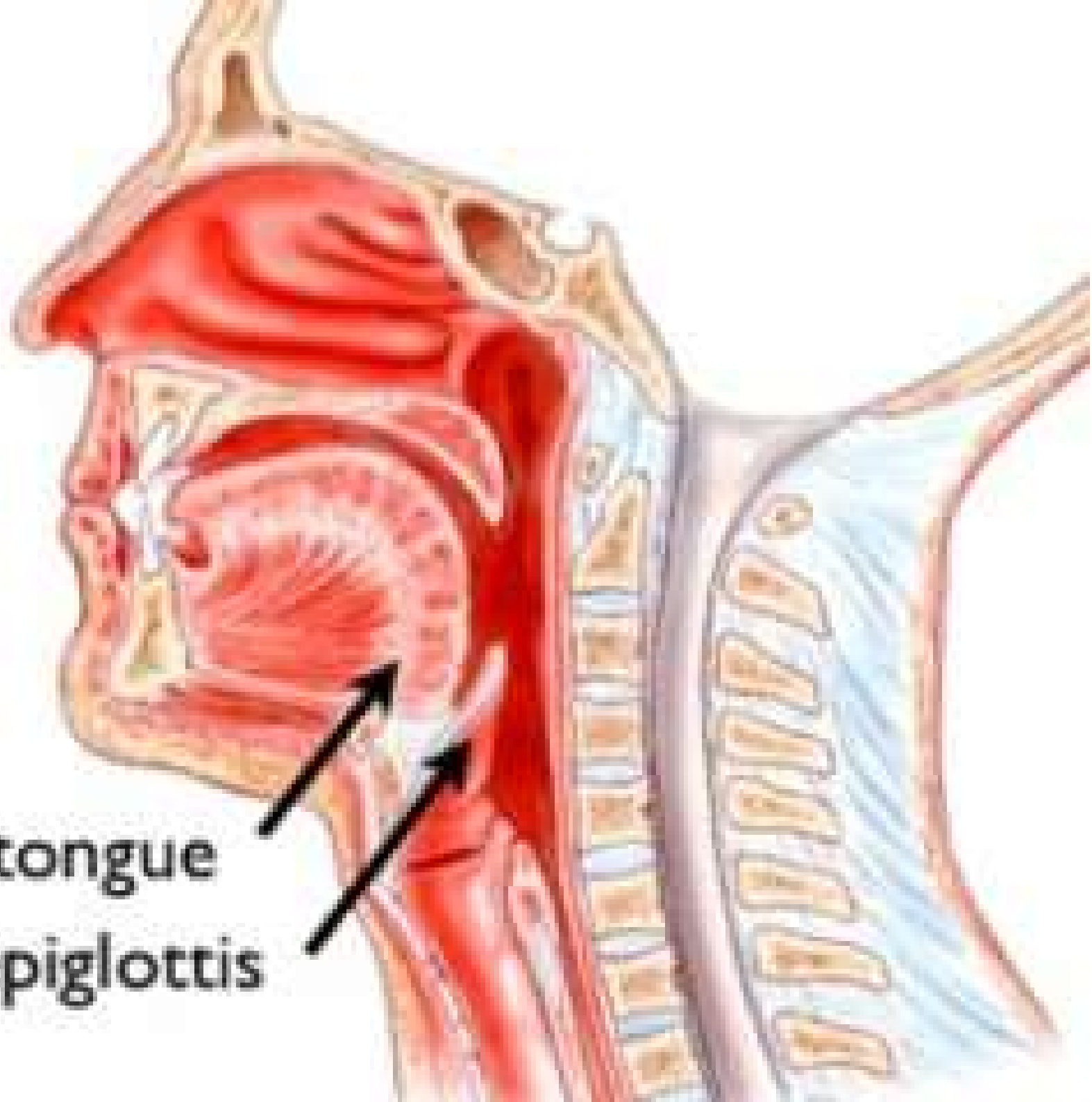
Normal Epiglott



Epiglottitis



Anxiety-provoking interventions such as phlebotomy, intravenous line placement, placing the child supine, or direct inspection of the oral cavity **should be avoided** until the airway is secure.



Base of tongue
epiglottis



Establishing an airway by **nasotracheal intubation** or, less often, by tracheostomy is indicated in patients with epiglottitis, **regardless of the degree of apparent respiratory distress**, because as many as **6%** of children with epiglottitis without an artificial airway die, compared with **<1%** of those with an artificial airway.

children with acute epiglottitis are intubated for ۲-۳ days, because the response to antibiotics is usually rapid .

Most patients have concomitant bacteremia; occasionally, other infections are present, such as pneumonia, cervical adenopathy, or otitis media. Meningitis, arthritis, and other invasive infections with H. influenzae type b are rarely found in conjunction with epiglottitis.

Racemic epinephrine and corticosteroids
are ineffective.

Cultures of blood, epiglottic surface, and,
in selected cases, cerebrospinal fluid
should be collected after airway
stabilization.

Treatment:

Ceftriaxone, cefotaxime, or
Meropenem
AND
Vancomycin

antibiotics should be continued for
7-10 days.

Indications for rifampin prophylaxis
(20 mg/kg orally once a day for 4 days;
maximum dose, 600 mg)
for all household members are:

- (1) any contact < 48 mo of age who is incompletely immunized;
- (2) any contact < 12 mo who has not received the primary vaccination series
- (3) an immunocompromised child in the household.

Acute Infectious Laryngitis

Viruses cause most cases; diphtheria is an exception but is extremely rare in developed countries

The onset is usually characterized by an upper respiratory tract infection during which sore throat, cough, and hoarseness appear. The illness is generally mild; respiratory distress is unusual except in the young infant. Hoarseness and loss of voice may be out of proportion to systemic signs and symptoms.

The physical examination is usually not remarkable except for evidence of pharyngeal inflammation. The principal site of obstruction is usually the subglottic area.

Bacterial Tracheitis

life-threatening airway obstruction

Staphylococcus aureus is the most commonly isolated pathogen.

Moraxella catarrhalis,
non-typable H. influenzae,
anaerobic organisms

Streptococcus pyogenes,
Streptococcus pneumoniae

the mean age has been between
 Δ and γ yr.

Bacterial tracheitis often follows a viral respiratory infection (a bacterial complication of a viral disease).

This life-threatening entity is more common than epiglottitis in vaccinated populations.

Typically, the child has a
brassy cough,
High fever and "toxicity" with
respiratory distress may occur
immediately or after a few days of
apparent improvement.

The patient can lie flat, does not drool, and does not have the dysphagia associated with epiglottitis

50-60% of patients required intubation

The major pathologic feature appears to be mucosal swelling at the level of the cricoid cartilage complicated by copious thick, purulent secretions

X-rays are not needed but may show
the classic findings .
(pseudomembrane detachment)

purulent material is noted below the
cords during endotracheal intubation

TREATMENT:

antistaphylococcal agents

artificial airway should
be strongly considered

Toxic shock syndrome
has been associated with
staphylococcal tracheitis.