

# *Acute Laryngitis in Childhood*

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## **Viral croup**

### **Definition**

The term “croup syndrome” characterizes a group of diseases with variable anatomic involvement and etiology, and is clinically manifested with the following symptoms: hoarseness, barking cough, predominantly inspiratory stridor and varying degrees of respiratory discomfort. It is named viral croup when the syndrome has a viral etiology. Other etiologies of this syndrome include bacterial tracheitis and diphtheria.

The disease can also be classified according to the degree of the airways involvement by the respiratory viruses. Thus, the disease is called laryngitis if restricted to the larynx and is mainly characterized by hoarseness and barking cough. If the inflammation involves the larynx and the trachea, the resulting laryngotracheitis has characteristic croup symptoms. If the bronchioles are also involved, the disease is called laryngotracheobronchitis and involves extended expiratory time and wheezing.

### **Etiology and epidemiology**

Laryngotracheobronchitis is the most common cause of upper airway obstruction in children, accounting for 90% of stridor cases. The disease is responsible for 15% of respiratory tract disease in the childhood.

The viral etiology of croup is trivial, the main agents being parainfluenza virus (types 1, 2 and 3), A and B influenza virus and Respiratory Sinititial Virus (RSV).

It occurs in children with ages between 1 and 6 years, with a peak incidence at 18 months of age, predominantly in boys. This range age is more prone to the development of the disease since these children are generally experiencing their first infection by these agents, favoring viral aggression throughout the airway. In adults, local immunity restricts the disease to the nasopharynx. Although most cases occur in autumn and winter, viral croup can be found all year around.

### **Pathogenesis**

The viral infection starts in the nasopharynx and spreads through the larynx, trachea and bronchoalveolar tree respiratory epithelium. The physical exam will reveal different findings, according to the degree of respiratory epithelium lesion. There is diffuse inflammation, erythema and edema of the trachea walls and

alteration in the vocal chords mobility. The subglottic region mucosa has low little adherence allowing the formation of significant edema with potential involvement of the airway. In infants, 1 mm of edema in the subglottic region causes a 50% reduction in the tracheal diameter. The airflow is significantly decreased by the edema in the subglottic region of the trachea (narrowest portion of the upper airway in children), generating inspiratory stridor.

### Clinical presentation

The disease starts with clear rhinorrhea, pharyngitis, mild cough and low fever. In the croup syndrome, symptoms of upper airway obstruction start after 12 to 48 hours and are characterized by progression of the respiratory failure signs and increase in body temperature.

The symptoms are generally solved in 3 to 7 days. In more severe cases, there is increased heart and respiratory rates; clavicular, sternal and diaphragm retraction; nostril movement; cyanosis; psychomotor agitation and even sleepiness. Children who have undergone previous manipulation of the upper airways (surgery or intubation) or had a local disease need a more careful approach.

Most children with laryngotracheitis have mild symptoms, which do not progress to progressive airway obstruction. There are several score systems proposed to evaluate the severity of airway obstruction, based on clinical findings (**Table 1**). Children younger than 6 months of age, patients with stridor at rest, alteration of consciousness level and hypercapnia are under potential risk for development of respiratory failure. Pulse oximetry should be performed in all children with stridor. However, it is important to emphasize that normal oxygen saturation can give a false impression of this being a low-risk disease. Hypoxia is generally indicative of advanced disease and imminent respiratory failure.

**Table 1.** Clinical score for assessment of stridor

SIGN	0	1	2	3
Stridor	Absent	With agitation	Mild at rest	Severe at rest
Retraction	Absent	Mild	Moderate	Severe
Air entrance	Normal	Normal	Reduced	Very reduced
Color	Normal	Normal	Cyanotic under agitation	Cyanotic at rest
Consciousness level	Normal	Agitation under stimulus	Agitation	Lethargic

Total score total: < 6 = mild; 7-8 = moderate; > 8 = severe

Adapted from Tausig LM, Castro O, Biandry PA, et al. *Am J Dis Child* 1975;129:790-95

### Diagnosis

Diagnosis is based on clinical findings but classical cervical X-ray findings, the narrowing of the subglottic trachea (*pencil point* or *church tower sign*), do not have much value, as they may also be present in a healthy child as an anatomic narrowing of the subglottic region. In addition, 50% of children with viral croup have normal cervical X-ray. Therefore, the radiological exam is reserved for the diagnostic investigation of other etiologies for croup symptoms (aspiration of foreign body) or cases in which the disease outcome is atypical. The virus isolation

by immunologic methods is useful in cases of doubtful etiology or clinical protocols, and should not be included in the initial laboratory assessment.

### **Treatment**

The objective of the treatment is to maintain the airways patency.

### ***Nebulization***

The use of nebulization with saline or humidified air, although usual, has no proven efficacy. Nebulization must be discouraged if the child becomes more agitated by the procedure, as it causes turbulence in the upper airway inflow. The child should be in a calm environment and in the parent's lap while nebulization is administered. The nebulization should be given as a source of oxygen if hypoxemia is detected.

### ***Cortico-steroids***

It has been widely shown that there is clinical improvement with the use of cortico-steroids, reducing the severity of symptoms, the need for hospitalization, reducing hospitalization time or time spent in the emergency service, reducing the need for admission in Intensive Care Unit (ICU) and the need of association with other drugs (epinephrine). Dexamethasone was extensively studied as a potent glucocorticoid and its long period of action (more than 48 hours). It can be given by oral or parenteral administration, as a single dose ranging from 0.15mg/kg (mild croup) up to 0.6mg/kg (severe croup). Inhaled budesonide reduces the severity of croup symptoms when compared to placebo, and is similar to dexamethasone in cases of mild or moderate croup at a 2mg inhalation dose.

### ***Epinephrine***

It acts by stimulating alpha-adrenergic receptors, with subsequent constriction of arteriolar capillaries. Inhaled epinephrine has a dramatic effect on croup symptoms, reducing stridor and respiratory failure symptoms. As the drug effect is short (2 hours), the patient can experience respiratory discomfort again when the drug activity is over, and should therefore remain in the Emergency Department for 3 to 4 hours after the use of epinephrine. The discharge criteria include: absence of stridor at rest, normal air inflow, normal color, normal consciousness level and previous use of dexamethasone. The epinephrine indications include: moderate to severe croup and children that have undergone previous upper airway manipulation or procedure. The dose for inhalation is 0.5 mL 2.25% racemic epinephrine in 2.5 mL saline solution or 5 mL epinephrine 1:1000 (as effective and safe as the racemate form). Most studies have used the same dose in all children regardless of their size and clinical experience suggests that "back-to-back" doses of epinephrine may be used in cases of impending respiratory failure. The repeated dose of epinephrine should be used with caution because there is risk of ventricular tachycardia and myocardial infarction.

### ***Intubation***

Most children with laryngotracheitis do not need intubation after using epinephrine and dexamethasone. The manipulation is difficult because it is a sick airway; this age group presents an anatomical difficulty; the child's psychomotor agitation; and the risk of total airway obstruction. It is a general consensus, however, that the procedure should be performed in a patient with imminent airway obstruction

in a well-controlled environment, with well-controlled protocols, by experienced professionals with an anesthesiologist and otorhinolaryngologist or pediatric surgeon present. The internal diameter of the tracheal cannula should be 0.5 mm less than the ideal calculated for the child's age.

### **Hospitalization**

The decision to admit or discharge a child with croup can be a difficult task. In general, admitted children have: 1) toxemia; 2) dehydration or are unable to ingest liquids; 3) significant stridor or retractions at rest; 4) no response to epinephrine or clinical worsening 2-3 hours after its administration; 5) no reliable parents (**Table 2**).

**Table 2.** Treatment of viral croup

SEVERITY OF SYMPTOMS	TREATMENT
Mild croup	<ul style="list-style-type: none"> <li>• Dexamethasone 0.15-0.3mg/kg oral or parenteral</li> <li>• Discharge home</li> </ul>
Moderate croup	<ul style="list-style-type: none"> <li>• Nebulization with racemic epinephrine 2,25%: 0,5mL in 2,5mL saline or 5mL epinephrine 1:1000</li> <li>• Dexamethasone 0.3-0.6 mg/kg oral or parenteral or inhalatory Budesonide: 2mg</li> <li>• Remain in Emergency Department for 3-4 hours and discharge home or admission in hospital</li> </ul>
Severe croup	<ul style="list-style-type: none"> <li>• Nebulization with racemic epinephrine 2,25%: 0,5mL in 2,5mL saline or 5mL epinephrine 1:1000</li> <li>• Dexamethasone 0.6 mg parenteral</li> <li>• Admission in Intensive Care Unit</li> </ul>

Adapted from Kaditis AG, Wald Er. *Pediatr Infect Dis* 1998;17:827-834.

### **Differential diagnosis**

With the introduction of *H. influenzae* type B vaccine, cases of infectious supraglottitis have been markedly reduced. Supraglottitis is a differential diagnosis for infectious obstruction of the upper airways; however, it is not characterized by croup symptoms. Obstruction causes stridor and respiratory discomfort in infectious supraglottitis, but there is no hoarseness nor barking cough that are typical of the vocal chords and trachea involvement, which are spared in this disease. The children with supraglottitis are toxic-appearing have circulatory perfusion alteration, which are typical of bacteremia and absent in viral croup. Other differential diagnoses include: angioneurotic edema, foreign body aspiration, bacterial tracheitis, retropharyngeal or peritonsillar abscess and infectious mononucleosis.

### **Spasmodic croup**

Much has been written to differentiate spasmodic croup from viral croup, but this differentiation is useless for the clinical practitioner.

The spasmodic croup is different from the viral croup as it causes a non-inflammatory edema of the subglottic tissues, suggesting that there is no viral involvement of the tracheal epithelium. In the endoscopic exam of the larynx, the mucosa is pale in the spasmodic croup and erythematous and inflamed in viral

croup. Although there is an association with the same viruses that cause viral croup, the reason for this sudden edema is not known. It has been suggested that the spasmodic croup seems to be much more an allergic reaction to viral antigens than a straight viral infection.

Spasmodic croup occurs in children from 3 months to 3 years of age. The child remains in a good general condition and shows common cold symptoms. At night, the child wakes up with sudden dyspnea, hoarseness, barking cough and inspiratory stridor. There is no fever and the child generally improves after being calmed down and receiving nebulization.

Some children present multiple episodes of croup. This description is more consistent with spasmodic croup recurrence than separates episodes of viral croup. There are reports of more than 3 episodes in 30% of the children, more than 5 episodes in 17%, and more than 9 episodes in 6%.

If there is no spontaneous resolution of the symptoms, the treatment for viral laryngotracheitis can be used; however, this is only necessary in few cases. There is no indication for the use of antihistamine, non-hormonal antiinflammatory drugs, antibiotics, antitussives, decongestants or inhalation with nasal vasoconstrictors in both viral and spasmodic croup.

### **Recommended readings**

1. Kaditis AG, Wald ER. Viral croup: Current diagnosis and treatment. *Pediatr Infect Dis J* 1998; 17:827-834.
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