



### Key points

- ▶ The term "croup" refers to a clinical syndrome characterised by barking cough, inspiratory stridor and hoarseness of voice.
- ▶ The standard work-up for clinical diagnosis includes the assessment of skin colour, hydration, breath sounds and air movement.
- ▶ The most important aspect in the treatment of patients with croup is airway maintenance.
- ▶ The standard management of croup includes corticosteroids and L-adrenalin.
- ▶ L-adrenalin is used because it is safe, cheap and available across the world.

# Croup: diagnosis and treatment

## Educational aims

- ▶ To provide information on how to diagnose, treat and hospitalise patients with croup.
- ▶ To enable clinicians to determine the appropriate treatment for every situation, according to score.
- ▶ To explain the rationale of treatment.

## Summary

"Croup" (laryngotracheobronchitis) is a common illness during the first 6 years of childhood, which is characterised by barking cough, inspiratory stridor and hoarseness of voice. Patients with atypical features in whom the diagnosis is questionable or unclear should have a work-up to exclude other less common entities.

The most important aspect of the treatment is airway maintenance, and standard management includes corticosteroids and L-adrenalin.

Inhaled L-adrenalin has a transient beneficial effect on airway obstruction in children; even if it is not a definitive treatment, it may allow time for the basic pathology to resolve.

Croup is a common childhood illness, and viral croup is the most common form of airway obstruction in children aged 6 months to 6 years, peaking between the ages of 1 and 2 years [1–4]. Males are affected more frequently than females (1.5:1.0) [5], and, although the disease can occur throughout the year, it predominates in the autumn and winter months.

The term croup refers to a clinical syndrome characterised by barking cough, inspiratory stridor and hoarseness of voice. It results from viral infection, causing inflammation and oedema of the upper airway, including the larynx, trachea and bronchi (hence the term laryngotracheobronchitis), resulting in subglottic narrowing [6, 7]. The symptoms get worse at night, and may peak on the 2nd or 3rd night. Spasmodic croup, which is characterised by recurrent attacks of inspiratory stridor with viral infections in children with bronchial hyperreactivity, is sometimes seen as

a separate entity, but acute treatment does not differ from that of common croup (table 1) [8].

Usually, croup is mild in the majority of children. More severe cases of croup are traditionally referred to hospital in order to manage potentially life-threatening airway obstruction. Prior to the introduction of steroid therapy, intubation was required in ~2% of those hospitalised patients [9–12].

## Clinical manifestation

The symptoms of croup are presented in table 2 [8]. The clinical signs of severe obstruction include pallor and lethargy, marked intercostals and sternal indrawing, restlessness and tachycardia. Cyanosis is a late sign and always indicates very severe obstruction. The loudness of the stridor is not a good guide to the severity of illness. Auscultation of the chest usually

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**Table 1 Comparison of upper airway obstructions**

	<b>Laryngotracheobronchitis (viral croup)</b>	<b>Spasmodic croup</b>	<b>Epiglottitis</b>	<b>Foreign body obstruction</b>
<b>Age range</b>	0-5 years	6 months-3 years	2-7 years	Newborn to adult
<b>Aetiology</b>	Parainfluenza Influenza Adenovirus RSV	? Viral ? Airway reactivity	H. influenzae S. aureus (rarely)	Object small enough to fit in mouth or nares
<b>Onset</b>	Insidious	Sudden	Sudden	Sudden
<b>Clinical manifestations</b>	Low-grade fever Nonseptic Barking cough Stridor Hoarse	Afebrile Nonseptic Barking cough Stridor Hoarse	High fever Septic Non-barking cough Muffled voice Drooling Dysphagia Sitting, leaning forward	Afebrile Respiratory distress "Choking"

RSV: respiratory syncytial virus. Data modified from [8].

reveals only transmitted upper airways noise. If breath sounds are reduced in volume, this also indicates severe illness.

A diagnosis can usually be made from a clinical assessment, which includes an examination of skin colour, hydration, breath sounds and air movement. In cases of severe croup, or if atypical signs are present suggesting a different diagnosis, further investigations are necessary. A chest radiograph is not part of the standard assessment, but it is useful in severe cases or when the diagnosis is unclear (table 3) [10]. Only 50% of patients with croup show the classic "steeple" sign on plain neck radiography [11]. The steeple sign results from a narrowed column of subglottic air seen on a posterior-anterior radiograph (figure 1).

Certain children are at an increased risk of severe disease, e.g. those with pre-existing upper airways narrowing, such as subglottic stenosis (usually following prolonged neonatal ventilation). Children with Down's syndrome also have greater problems with croup due to narrow upper airways and should be managed with caution.

Patients with atypical features, i.e. those aged >6 years or with high fever, in whom the diagnosis is questionable or unclear should have an additional work-up to exclude other less common entities, such as retropharyngeal abscess, epiglottitis, bacterial tracheitis and/or foreign bodies (table 4). This may include: cell blood count and blood culture (if epiglottitis is suspected); soft-tissue plain radiography of the neck (if there is doubt about the diagnosis at the

**Table 2 Clinical manifestations**

Constitutional state (toxicity, fever, pulse rate)	Tachypnoea
Stridor	Tracheal tug on inspiration
Drooling	Intercostal and subcostal indrawing on inspiration
Barking cough	Asynchrony of chest and abdominal wall movement
Speech	Cyanosis in air

Table modified from [8].

**Table 3 Standard work-up for diagnosing croup**

<b>Examination</b> Assess skin colour, breath sounds, air movement, hydration	<b>Advice</b> Leave the child in a comfortable position Do not insert tongue depressor Do not take blood Do not perform radiography if not necessary#
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#: subglottic narrowing on the posterior-anterior view of the upper airway and normal epiglottis on the lateral airway neck radiograph. Table modified from [12].



**Figure 1**

The classic steeple sign of croup as shown on neck radiography, with a narrowed column of subglottic air (upper arrow) and an enlargement of the column (lower arrow).

direct inspection); and computed tomography scan of the neck with *i.v.* contrast (in the case of retropharyngeal abscess).

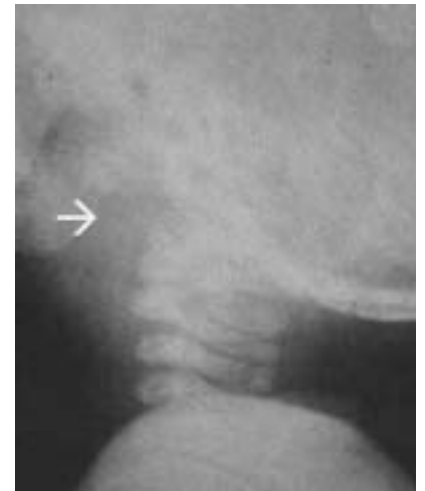
The classical radiography signs are the following:

1. The "thumb" sign in the epiglottitis on the lateral airway neck film (figure 2), due to oedema of the epiglottis thickening the free edge. The posterior-anterior radiograph is usually unremarkable.

2. A widening of the retropharyngeal space, due to the abscess (figure 3). Measuring at the level of C2, the normal distance from the anterior surface of the vertebrae to the posterior border of the airway should be  $\leq 7$  mm, regardless of the patient's age. A simpler (but less precise) rule is that the soft-tissue plane should be less than one half width of the corresponding vertebral body [13].

#### Table 4 Differential diagnosis

Epiglottitis  
Bacterial tracheitis  
Laryngeal foreign body  
Subglottic haemangioma  
Subglottic stenosis  
Retropharyngeal abscess  
Thermal or chemical injury



**Figure 2 (Left)**

The characteristic "thumb" sign in the epiglottitis. An oedema of the epiglottis has thickened the free edge (arrow).

**Figure 3 (Right)**

Retropharyngeal abscess. Arrow indicates the vertebral body.

## Treatment

The results of a meta-analysis have shown that treatment with glucocorticoids is effective in improving the symptoms of croup in children after only 6 hours and for up to 12 hours after treatment, with significant improvement in scores of croup severity, shorter hospital stays and less use of adrenaline [6]. The effectiveness of oral or intramuscular dexamethasone ( $0.6 \text{ mg kg}^{-1}$ ) as a treatment for patients with moderate-to-severe croup is well established [2, 14–16]. Doses of dexamethasone ranging  $0.15\text{--}0.6 \text{ mg kg}^{-1}$  have been shown to be similarly efficacious for treating moderate croup (table 5) [17]. Recently, two studies have suggested that the use of single-dose oral dexamethasone treatment for mild croup demonstrates more rapid symptom resolution, with important clinical and economical benefits [18, 19]. Commonly used alternatives to dexamethasone are prednisone or prednisolone ( $1\text{--}2 \text{ mg kg}^{-1}$ ) [6, 20]. The use of nebulised budesonide ( $2 \text{ mg}$ ) to treat patients with moderate croup has been shown to be effective [21–25]. Nebulised budesonide, and oral and intramuscular dexamethasone have the same effectiveness for treatment of moderate croup, and the choice depends on the status of the patient [26–28].

Inhaled  $\text{L}$ -adrenalin has a temporary beneficial effect on airway obstruction in children with croup. It is not a definitive treatment, but may allow time for the basic pathology to resolve. Normal  $\text{L}$ -adrenalin is preferred to racemic adrenaline, since it is safe, cheap and easily available worldwide [29–33]. The association of a nebulised steroid (*i.e.* beclomethasone or budesonide) improves the efficacy of  $\text{L}$ -adrenalin, since the steroid begins to work when  $\text{L}$ -adrenalin decreases [33].



**Table 5** Outpatient management of croup

Mild croup (score 0–1)#	Moderate croup (score 2–7)#	Severe croup (score ≥8)#
Barking cough, no clinical signs of obstruction stridor at rest	Minimal accessory muscle use and/or at rest and distressed	Some accessory muscle use/recessions and stridor cyanosis, $SO_2 < 92\%$ in air) or signs of severe obstruction (marked accessory muscle use/recessions)
No specific treatment indicated $0.15 \text{ mg}\cdot\text{kg}^{-1}$ or prednisolone $0.15 \text{ mg}\cdot\text{kg}^{-1}$	Dexamethasone $1 \text{ mg}\cdot\text{kg}^{-1}$ orally	1. Dexamethasone $1 \text{ mg}\cdot\text{kg}^{-1}$ orally or budesonide $2 \text{ mg}$ nebulised if p.o. not possible 2. Nebulised L-adrenalin ( $0.5 \text{ mL}\cdot\text{kg}^{-1}$ of 1:1000 L-adrenalin solution, maximum 5 mL, diluted with saline)
1. Advise parents that "steam" may help during periods of increased distress and to return if there are any signs of increased obstruction 2. Give parent information leaflet 3. Discharge without further observation	Discharge 3 hours after initial treatment if stable or improved	Discharge 4 hours after initial treatment if stable or improved
		1. Close clinical monitoring 2. Bag–valve–mask ventilation (child might require intubation and transfer to ICU) 3. Admit for further evaluation

*SO<sub>2</sub>: oxygen saturation; ICU: intensive care unit. #: Westley croup score.*



A clinical croup score (according to Westley) should be recorded before and after each treatment, and a note made of any complications (table 6). A score of  $\geq 2$ , if there is some accessory muscle use/recessions and stridor at rest, is considered to indicate moderate-to-severe airway obstruction and require the following: 1) monitoring for oxygen saturation and heart rate; and 2) powering of the treatment by oxygen.

Contraindications to the administration of L-adrenalin include obstructive right, left or cyanotic cardiac lesions. Further caution should be used with hypertensive patients.

Children receiving nebulised adrenaline must be observed for a minimum of 2 hours in the emergency department prior to discharge and should only be discharged after the clinician is convinced that the parent/guardian thoroughly understands the disease process and is able to return to the emergency department expeditiously should stridor recur.

Children requiring two or more nebulisations of adrenaline should be admitted to the hospital. Table 7 lists the indications for the hospitalisation of patients with croup [34].

**Table 6** Westley croup score

<b>Stridor</b>	
0	None
1	When agitated or at rest, audible with stethoscope
2	At rest, audible without stethoscope
<b>Retractions</b>	
0	None
1	Mild
2	Moderate
3	Severe
<b>Air entry</b>	
0	Normal
1	Decreased but easily audible
2	Markedly decreased
<b>Cyanosis<sup>#</sup></b>	
0	None
1	With agitation
2	At rest
<b>Level of consciousness</b>	
0	Normal (including sleep)
5	Altered mental state, disoriented

<sup>#</sup>:  $SO_2 < 92\%$  on air.

**Table 7** Indications for croup hospitalisation

Actual or suspected epiglottitis  
 Cyanosis  
 Depressed sensorium  
 Hypoxaemia  
 Pallor  
 Progressive stridor  
 Respiratory distress  
 Restlessness  
 Stridor at rest  
 Toxic-appearing child  
 At-risk patients (young infants, subglottic stenosis, Down's syndrome)  
 Atypical croup

**Educational questions**

1. What are the main clinical symptoms and signs of severe croup?
2. Is a radiography examination necessary to diagnose croup?
3. What are the contraindications of adrenalin aerosol treatment?
4. When should a child be hospitalised?

**Suggested further reading**  
 Knutson D, Aring A. Viral croup. *Am Fam Physician* 2004; 69: 535–540.

Waisman Y, Klein BL, Boenning DA, et al. Prospective randomized double-blind study comparing L-epinephrine and racemic epinephrine aerosol in the treatment of laryngotracheitis (croup). *Pediatrics* 1992; 89: 302–306.

Bjornson C, Klassen T, Williamson J, et al. A randomized trial of a single dose of oral dexamethasone for mild croup. *N Engl J Med* 2004; 351: 1306–1313.

## The future

Due to substantial prevalence (15% of respiratory tract infections in children, with 1–5% of children requiring outpatient evaluation) and different therapeutic approaches for croup, the following issues are currently being debated.

1. Differentiating spasmodic from viral croup  
 Even if patients with spasmodic croup develop symptoms suddenly, without a clearly identifiable viral prodrome, the distinction is not often possible. Although associated with the same viruses that cause croup, spasmodic croup tends to recur and may represent an allergic reaction to viral antigens instead of a direct infection. Furthermore, the mean duration of illness is usually lower (hours instead of days) and less evident than viral croup. From a practical point of view, the therapeutic approach is the same.
2. Are children with a history of croup at

increased risk of developing asthma?

Patients with recurrent croup, especially with a history of hospital admission, have a higher prevalence of bronchial hyperresponsiveness, allergic skin response and increased total serum immunoglobulin E levels compared to those with mild or no croup. Children who present with croup may or may not be at increased risk of subsequent recurrent lower airway obstruction, depending on the initial lower airway obstruction, and pre-illness and post-illness abnormalities in lung function.

3. What is the role for corticosteroids and which is the preferred way of administration?  
 Nebulised budesonide, and oral and intramuscular dexamethasone have the same effectiveness for treating moderate croup and the choice depends the condition of the patient.
4. Racemic or L-adrenalin?  
 The latter is preferred, since it is safe, much more cheap and easily available all over the world.

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## Suggested answers

1. The main clinical symptoms and signs are: pallor and lethargy; marked intercostals and sternal indrawing; restlessness; tachycardia; and reduced breath sounds.
2. Radiography is not part of the standard assessment, and it is only useful in severe cases or when the diagnosis is unclear.
3. Contraindications to the administration of L-adrenalin include obstructive right, left or cyanotic cardiac lesions. Further caution should be used with hypertensive patients.
4. In case of severe obstruction, restlessness, stridor at rest, atypical features, subglottic stenosis, Down's syndrome or toxic-appearing child.