

**ACUTE
LARYNGOTRACHEITIS**

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Acute Laryngotracheitis can be defined as subacute viral illness characterized by low grade fever, barking cough, inspiratory stridor and expiratory rhonchi. It is also known as infectious croup. Croup is an old Scottish word for sore throat with harsh breathing. It is seen in children between 3 months to 3 years of age (mean age 18 months)(1). Boys are more frequently affected. It occurs more commonly in winter months with a peak in November in temperate climate(2), and often another peak in early spring(1). Para influenza viruses 1 and 2 and influenza A are the primary etiologic agents. It represents about 1 to 3 of every 1000 admissions to a pediatric hospital(3).

Infectious croup should be distin-

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guished from the spasmodic croup which is an ill defined entity characterized by acute onset of barking cough, dyspnea and stridor, and may be associated with upper respiratory tract infection but usually without fever. It occurs usually during night as the proximal tongue falls back during sleep compromising the airway causing obstruction and difficulty in breathing(4). These spasmodic attacks are often of recurrent nature. More than two episodes of croup are grouped as recurrent croup(5). It occurs in children between 2 and 5 years of age. The rapid onset and relief of obstruction is due to laryngospasm rather than to inflammatory edema. The outcome of spasmodic croup is excellent. A congenital obstruction should be considered in children with recurrent croup who are under 2 years of age. The spasmodic croup almost always resolves with humidity and reassurance(6,7) and it is not life threatening.

Physiological Considerations

The larynx in young children is relatively and absolutely smaller than in adults and is placed higher up in the neck, the mucosa of subglottis (without cricoid ring) is lax, full of mucus glands and easily becomes edematous, causing biphasic stridor as this is the only part of the laryngotracheobronchial tree which is completely surrounded by cartilage. It is rigid and airflow is restricted in both inspiratory and expiratory phases(1). Laryngeal spasm occurs more easily in children than in adults. The childhood larynx is physiologically more brittle. The resistance to airflow in

affected children can be considered according to Poiseuille's Law which states that airway resistance changes as the fourth power of radius. One mm or edema in an infant larynx reduces the glottic area by 65%(8). Edema of 1 mm in a 6 mm airway leaves a lumen of 4 mm. An equal swelling in a narrowed airway of 3 mm leaves a 1 mm lumen(9). So even a minor degree of subglottic edema will produce a disproportionately large increase in airway resistance.

Management

A careful history and clinical examination helps to arrive at a proper diagnosis. It is always better to suspect the worst as an underestimation may lead to a catastrophic outcome especially with an exhausted child who attempts to 'fake' being well(10).

The clinical features of upper airway obstruction include increased respiratory rate, flaring of alae nasi, increased suprasternal and intercostal recessions and change in cry. The presence of tachycardia, anxiety and restlessness are early indicators of cerebral hypoxia. There is good correlation between severity of the respiratory airway obstruction and the respiratory rate. Pulse rate is less reliable(11).

Diagnosis

Airway radiographic films may show subglottic narrowing. A lateral neck radiograph from nose to trachea can help to rule out epiglottitis (thumb sign), retropharyngeal abscess or any radiopaque foreign body. However, the interpretation of these X-rays requires expertise. Often such X-rays are taken in emergency and the films are not of good

quality. The abnormalities of airway secondary to patient's positioning, swallowing and movement may also cause artefacts on the X-ray film leading to misinterpretation. Almost one-third of skiagrams of neck may be reported false positive by the attending doctor(12). A non pediatric radiologist reads the film correctly 50% of the time while a pediatric radiologist reads the film correctly 92% of the time. Approximately 13% of the X-ray are technically unsatisfactory(9). The X-ray may be misleading if it is not taken during inspiration. The approximation of vocal cords during expiration may easily lead to misinterpretation as glottic obstruction. Even the "steep sign" considered to be diagnostic of laryngotracheitis is not specific. Only 33% of patients with croup had an accurate radiographic diagnosis(3). The lateral airway film in the proper hand can be extremely useful but has specific limitation(13). The clinical judgement must form the basis of diagnosis while skiagram is used as screening procedure and can only support the clinical diagnosis. The skiagram should be taken only after airway has been secured or normal respiration has been restored(11). Fortunately most of the laryngeal foreign bodies are radiopaque and are detected by plain skiagram. The problem occurs if a radiolucent foreign body is lodged in proximal airway which often cannot be visualized by lateral neck skiagram. A history of aspiration is frequently absent. Hearing of respiratory sound by keeping the ear next to the mouth of child can give useful information as presence of whistling sound causes suspicion of foreign body in the larynx. All cases of frequent and recurrent episodes of stridor warrant

endoscopic examination in the operation theatre, to confirm the presence of foreign body in the airway and determine the extent of involvement of laryngeal and tracheal mucosa(11). Esophagoscopy should be done whenever a foreign body is suspected but not found within the larynx, since sharp objects can penetrate the larynx from behind or get lodged in the esophagus just above the level of carina and cause tracheal stridor.

A scoring system to assess the severity of croup is a useful guide to assess the progress of a patient (Table I). A score more than 4 suggests moderately severe obstruction and calls for full conservative therapy. A score greater than 7 for a child who remains hypoxic and hypercarbic, despite full conservative therapy, indicates the need for an artificial airway(9).

Blood gas estimations are not very helpful in determining the need for provision of an artificial airway. The arterial carbon dioxide (PaCO₂) is an index of

the amount of air being passed. Most children will pass normal or increased volume of air despite severe obstruction. The PaCO₂ is thus usually within normal limits or low. A rising PaCO₂ with persisting airway obstruction or PaCO₂ above 45 mm of Hg indicates severe obstruction. The arterial oxygen tension (PaO₂) is even less helpful because PaO₂ is influenced by more variables than the PaCO₂. A very low level of PaO₂ or PaCO₂ above 45 mm of Hg and presence of cyanosis indicates impending death and require immediate intervention for assisted ventilation.

Therapy

Humidification

Humidification should be given by ultrasonic humidifier which emits water particles of less than 5 mm size and produce effective humidification. Continuous humidification is to be avoided especially when the infant is being nursed in the incubator as it may cause exfoliative dermatitis with secondary sepsis.

TABLE I—Clinical Croup Score(9)

Criteria	0	1	2
1. Inspiratory breath sounds	Normal	Harsh with rhonchi	Delayed
2. Stridor	None	Inspiratory	Inspiratory and expiratory
3. Cough	None	Hoarse cry	Bark
4. Retraction and flaring	None	Flaring and suprasternal retractions	As under 1, plus subcostal/intercostal retractions
5. Cyanosis	None	In air	In 40% O ₂

Humidification with steaming kettle produces large particles of water vapor and should be avoided(11).

Drugs

The efficacy of racemic epinephrine is time tested. It works as vasoconstrictor to decrease edema(10) and with intermittent positive pressure breathing it is effective in relieving upper airway obstruction. It is well suited for use in croup because the illness usually has run its course before tolerance to its effect can develop(14). Its side effect is minimal. The drug has virtually reduced the need of tracheostomy to zero. Unfortunately suspension of racemic epinephrine is not available in our country(4). Nebulized adrenaline in 1:1000 is an effective alternative and does enable some children to manage without intubation. The metabisulphite content of nebulized adrenaline (1:1000) might further damage the compromised respiratory tract. The irritant nature of sulphur dioxide released from sodium metabisulphide is well known to home brewers. Inhalation of sulphur dioxide in concentration of 6-12 ppm causes irritation of nose, throat and bronchoconstriction(15).

The role of corticosteroid in the treatment of acute croup remains controversial. It acts by stabilizing the lysosome membrane and diminishes the capillary permeability and dilatation. It reduces the course of illness by its anti-inflammatory action and reduces the incidence of tracheostomy and respiratory failure or both. Chaturvedi *et al.* (11) strongly recommend a single bolus dose of dexamethasone 1-1.5 mg/kg of body weight to a maximum of 30 mg by intra-

venous route. The hospital stay of child is short and there is faster recovery. The benefit obtained by using dexamethasone will probably be same as with methylprednisolone and prednisolone(16). The dangers of a single dose of steroids have never been demonstrated and it is relatively safe(14). In one retrospective study of 416 children admitted in TCU for croup in Australia(17), 66% children were successfully extubated in the first attempt while 34% were reintubated. Of those reintubated, 61% were given steroids prior to subsequent extubation. Only one child who received steroid had failed extubation. Of those 66% who had successful extubation in the first attempt, 59% required reintubation. Thus, the use of steroids significantly increased the incidence of successful extubation irrespective of the duration of intubation. Steroids thus remain a useful tool in all patients of acute laryngotracheitis.

Antibiotics have no place in the treatment of croup which usually improves in 3-5 days.

Ventilatory Support

Endotracheal intubation is not necessary in every patient of laryngotracheitis. However increasing respiratory distress manifested by cyanosis, stridor and retraction will require endotracheal intubation. Children who have more than two episodes of croup requiring hospital admission and endotracheal intubation should have a formal workup by an otolaryngologist to assess for possible subglottic narrowing from stenosis or cyst.

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