Infectious Upper Airway Obstruction

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Croup (LTB)

Objectives

1. Know and understand the aetiology and natural history of viral croup including knowledge of the common causative organisms.
2. Know the management options available, including drugs, oxygen and supportive therapy.
3. Be able to make a confident differential diagnosis for the various causes of upper airway obstruction.
4. Be able to advise parents about how to care for a child with viral croup.

Epiglottitis

Objectives

1. Be able to recognise the clinical features of epiglottitis.
2. Be able to distinguish epiglottitis from other causes of upper airway obstruction.
3. Know the management options available, including intubation, drugs, oxygen and supportive therapy.
4. Be able to advise parents about how to care for a child with epiglottitis.

Bacterial tracheitis

Objectives

1. Be able to recognise the clinical features of bacterial tracheitis.
2. Know the management options available, including intubation, drugs, oxygen and supportive therapy.
ETIOLOGY AND EPIDEMIOLOGY

1. Viral agents account for most acute infectious upper airway obstructions.
2. The exceptions are diphtheria, bacterial tracheitis, and epiglottitis.
3. The parainfluenza viruses (types 1, 2, and 3) account for ≈75% of cases; other viruses associated with this disease include influenza A and B, adenovirus, respiratory syncytial virus (RSV), and measles.
4. Most patients with croup (LTB) are between the ages of 3 mo and 5 yr, with the peak in the 2nd yr of life.
5. The incidence of croup is higher in males.
6. It occurs most commonly in the late fall and winter but may occur throughout the year.
7. Approximately 15% of patients have a strong family history of croup.
8. In the past, *Haemophilus influenzae* type b was the most commonly identified etiology of acute epiglottitis. Since the widespread use of the Hib vaccine, invasive disease due to *H. influenzae* type b in pediatric patients has been reduced by 80–90%.

CLINICAL MANIFESTATIONS

**Croup (Laryngotracheobronchitis):**

1. Most patients have an upper respiratory tract infection with some combination of rhinorrhea, pharyngitis, mild cough, and low-grade fever for 1–3 days before the signs and symptoms of upper airway obstruction become apparent.
2. The child then develops the characteristic “barking” cough, hoarseness, and inspiratory stridor.
3. The low-grade fever may persist, although temperatures may reach 39–40°C. Some children are afebrile.
4. Symptoms are characteristically worse at night and often recur with decreasing intensity for several days and resolve completely within a week.
5. Agitation and crying greatly aggravate the symptoms and signs.
6. The child may prefer to sit up in bed or be held upright.
7. Older children usually are not seriously ill.

**Physical examination**

1. May reveal a hoarse voice, coryza, normal to moderately inflamed pharynx,
2. A slightly increased respiratory rate.
3. Rarely, the upper airway obstruction progresses and is accompanied by an increasing respiratory rate; nasal flaring; suprasternal, infrasternal, and intercostal retractions; and continuous stridor.
4. Alveolar gas exchange is usually normal. Hypoxia and low oxygen saturation are seen only when complete airway obstruction is imminent.
5. The child who is hypoxic, cyanotic, pale, or obtunded needs immediate airway management.
6. Occasionally, the pattern of severe laryngotracheobronchitis is difficult to differentiate from epiglottitis, despite the usually more acute onset and rapid course of the latter.

7. Radiographs of the neck may show the typical subglottic narrowing or “steeple sign” of croup on the posteroanterior view. Radiographs should be considered only after airway stabilization in children who have an atypical presentation or clinical course. Radiographs may be helpful in distinguishing between severe laryngotracheobronchitis and epiglottitis, but airway management should always take priority.

**Acute Epiglottitis (Supraglottitis):**

1. This dramatic, potentially lethal condition is characterized by an acute potentially fulminating course of high fever, sore throat, dyspnea, and rapidly progressing respiratory obstruction.
2. Often, the otherwise healthy child suddenly develops a sore throat and fever.
3. Within a matter of hours, the patient appears toxic, swallowing is difficult, and breathing is labored.
4. Drooling is usually present and the neck is hyperextended in an attempt to maintain the airway. The child may assume the tripod position, sitting upright and leaning forward with the chin up and mouth open while bracing on the arms.
5. A brief period of air hunger with restlessness may be followed by rapidly increasing cyanosis and coma.
6. Stridor is a late finding and suggests near-complete airway obstruction. Complete obstruction of the airway and death can ensue unless adequate treatment is provided.
7. The barking cough typical of croup is rare.
8. Usually, no other family members are ill with acute respiratory symptoms.

**Diagnosis**

1. The diagnosis requires visualization of a large, “cherry red” swollen epiglottis by laryngoscopy.
2. In a patient in whom the diagnosis is certain or probable based on clinical grounds, laryngoscopy should be performed expeditiously in a controlled environment such as an operating room or intensive care unit.
3. 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.
4. If epiglottitis is thought to be possible but not certain in a patient with acute upper airway obstruction, the patient can undergo lateral radiographs of the upper airway first. Classic radiographs of a child who has epiglottitis show the “thumb sign”.
5. A physician skilled in airway management and use of intubation equipment should accompany patients with suspected epiglottitis at all times.
6. 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.
7. In general, children with acute epiglottitis are intubated for 2–3 days, because the response to antibiotics is usually rapid.
8. 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.

**Acute Infectious Laryngitis:**

1. Laryngitis is a common illness.
2. Viruses cause most cases; diphtheria is an exception but is extremely rare in developed countries.
3. The onset is usually characterized by an upper respiratory tract infection during which sore throat, cough, and hoarseness appear.
4. The illness is generally mild; respiratory distress is unusual except in the young infant.
5. Hoarseness and loss of voice may be out of proportion to systemic signs and symptoms.
6. The physical examination is usually not remarkable except for evidence of pharyngeal inflammation.
7. Inflammatory edema of the vocal cords and subglottic tissue may be demonstrated laryngoscopically.
8. The principal site of obstruction is usually the subglottic area.

**Spasmodic Croup:**

1. Spasmodic croup occurs most often in children 1–3 yr of age
2. Clinically similar to acute laryngotracheobronchitis, except that the history of a viral prodrome and fever in the patient and family are frequently absent.
3. Laryngoscopy reveals pale, watery edema with preservation of the epithelium (unlike the erythematous edema and destruction of the epithelium of acute infectious laryngotracheobronchitis).
4. Occurring most frequently in the evening or nighttime.
5. Spasmodic croup begins with a sudden onset.
6. The child awakens with a characteristic barking, metallic cough, noisy inspiration, and respiratory distress and appears anxious and frightened.
7. The patient is usually afebrile.
8. Usually, the severity of the symptoms diminishes within several hours, and the following day, the patient often appears well.
9. Similar, but usually less severe, attacks without extreme respiratory distress may occur for another night or 2.
10. Such episodes often recur several times.
DIFFERENTIAL DIAGNOSIS:

1. **Bacterial tracheitis**: An acute bacterial infection of the upper airway, does not involve the epiglottitis but, like epiglottitis and croup, is capable of causing life-threatening airway obstruction. *Staphylococcus aureus* is the most commonly isolated pathogen. *Moraxella catarrhalis*, non-typable *H. influenzae*, and anaerobic organisms have also been implicated.

2. **Diphtheritic croup**: Is extremely rare in developed countries. Early symptoms of diphtheria include malaise, sore throat, anorexia, and low-grade fever. Within 2–3 days, pharyngeal examination reveals the typical gray-white membrane, which may vary in size from covering a small patch on the tonsils to covering most of the soft palate. The membrane is adherent to the tissue, and forcible attempts to remove it cause bleeding. The course is usually insidious, but respiratory obstruction can occur suddenly.

3. **Measles croup**: Almost always coincides with the full manifestations of systemic disease and the course may be fulminant.

4. **Foreign body**: Sudden onset of respiratory obstruction can be caused by aspiration of a foreign body; the child is usually 6 mo–3 yr of age. Choking and coughing occur suddenly, usually without prodromal signs of infection, although children with a viral infection can also aspirate a foreign body.

5. **A retropharyngeal or peritonsillar abscess**: Can mimic respiratory obstruction CT scans of the upper airway are essential in evaluating these possibilities. Other possible causes of upper airway obstruction include extrinsic compression of the airway (vascular ring) and intraluminal obstruction from masses (laryngeal papilloma, subglottic hemangioma); these tend to have chronic or recurrent symptoms.

6. **Angioedema**: Of the subglottic areas as part of anaphylaxis and generalized allergic reactions.

7. **Edema after endotracheal intubation**.

8. **Infectious mononucleosis**

9. **trauma**

10. **Malformations of the larynx**.

11. **Early sign of asthma**.

12. **Vocal cord dysfunction**

13. **Accidental ingestion of very hot liquid**.

14. **Hypocalcemic tetany**

COMPLICATIONS:

1. Complications occur in ≈15% of patients with viral croup.

2. The most common is extension of the infectious process to involve other regions of the respiratory tract, such as the middle ear, the terminal bronchioles, or the pulmonary parenchyma.

3. Bacterial tracheitis may be a complication of viral croup rather than a distinct disease. If associated with *S. aureus*, toxic shock syndrome may develop.

4. Pneumonia, cervical lymphadenitis, otitis media, or, rarely, meningitis or septic arthritis can occur in the course of epiglottitis.

5. Mediastinal emphysema and pneumothorax are the most common complications of tracheotomy.
TREATMENT:

Croup (LTB):

1. The mainstay of treatment for children with croup is airway management.
2. Treatment of the respiratory distress should take priority over any testing.
3. Most children with either acute spasmodic croup or infectious croup can be managed safely at home. Mist has been traditionally used to treat croup. Given the risk of burns and the observation that cold night air is also beneficial led to the use of cool mist
4. Nebulized racemic epinephrine is an accepted treatment for moderate or severe croup. The mechanism of action is believed to be constriction of the precapillary arterioles through the β-adrenergic receptors, causing fluid resorption from the interstitial space and a decrease in the laryngeal mucosal edema. Traditionally, racemic epinephrine, a 1:1 mixture of the d- and l-isomers of epinephrine, has been administered. A dose of 0.25–0.75 mL of 2.25% racemic epinephrine in 3 mL of normal saline can be used as often as every 20 min. The indications for the administration of nebulized epinephrine include moderate to severe stridor at rest, the possible need for intubation, respiratory distress, and hypoxia. The duration of activity of racemic epinephrine is <2 hr. Therefore, observation is mandated. The symptoms of croup may reappear, but racemic epinephrine does not cause rebound worsening of the obstruction.
5. Patients can be safely discharged home after a 2–3 hr period of observation provided they have no stridor at rest; have normal air entry, normal color, and normal level of consciousness; and have received steroids.
6. Nebulized epinephrine should still be used cautiously in patients with tachycardia, heart conditions such as tetralogy of Fallot, or ventricular outlet obstruction because of possible side effects.
7. The effectiveness of oral corticosteroids in viral croup is well established. Corticosteroids decrease the edema in the laryngeal mucosa through their anti-inflammatory action. Oral steroids are beneficial, even in mild croup, as measured by reduced hospitalization, shorter duration of hospitalization, and reduced need for subsequent interventions such as epinephrine administration. Most studies that demonstrated the efficacy of oral dexamethasone used a single dose of 0.6 mg/kg; a dose as low as 0.15 mg/kg may be just as effective. Intramuscular dexamethasone and nebulized budesonide have an equivalent clinical effect; oral dosing of dexamethasone is as effective as intramuscular administration.
8. Antibiotics are not indicated in croup.
9. A helium-oxygen mixture (Heliox) may be effective in children with severe croup who may need intubation.
10. Children with croup should be hospitalized for any of the following: progressive stridor, severe stridor at rest, respiratory distress, hypoxia, cyanosis, depressed mental status, poor oral intake, or the need for reliable observation.
**Epiglottitis:**

Is a medical emergency and warrants immediate treatment with an artificial airway placed under controlled conditions, either in an operating room or intensive care unit.

1. All patients should receive oxygen en route unless the mask causes excessive agitation.

2. Racemic epinephrine and corticosteroids are ineffective.

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

4. *Ceftriaxone or cefotaxime* should be given parenterally, pending culture and susceptibility reports, because from 10–40% of *H. influenzae* type b cases are resistant to ampicillin.

5. After insertion of the artificial airway, the patient should improve immediately, and respiratory distress and cyanosis should disappear.

6. Epiglottitis resolves after a few days of antibiotics, and the patient may be extubated; antibiotics should be continued for 7–10 days.

7. **Tracheotomy and Endotracheal Intubation:** Endotracheal intubation or tracheotomy is required for most patients with bacterial tracheitis and all young patients with epiglottitis. It is rarely required for patients with laryngotracheobronchitis, spasmodic croup, or laryngitis. Severe forms of laryngotracheobronchitis that require intubation in a high proportion of patients have been reported during severe measles and influenza A virus epidemics. Assessing the need for these procedures requires experience and judgment because they should not be delayed until cyanosis and extreme restlessness have developed. The endotracheal tube or tracheostomy must remain in place until edema and spasm have subsided and the patient is able to handle secretions satisfactorily. It should be removed as soon as possible, usually within a few days. Adequate resolution of epiglottic inflammation that has been accurately confirmed by fiberoptic laryngoscopy, permitting much more rapid extubation, often occurs within 24 hr. Racemic epinephrine and dexamethasone (0.5 mg/kg/dose every 6 hr as needed) may be useful in the treatment of croup associated with extubation.

**PROGNOSIS:**

1. In general, the length of hospitalization and the mortality rate for cases of acute infectious upper airway obstruction increase as the infection extends to involve a greater portion of the respiratory tract, except in epiglottitis, in which the localized infection itself may prove to be fatal.

2. Most deaths from croup are caused by a laryngeal obstruction or by the complications of tracheotomy. Rarely, fatal out-of-hospital arrests due to viral laryngotracheobronchitis have been reported, particularly in infants and those patients whose course has been complicated by bacterial tracheitis.
3. Untreated epiglottitis has a mortality rate of 6% in some series, but if the diagnosis is made and appropriate treatment is initiated before the patient is moribund, the prognosis is excellent.

4. The outcome of acute laryngotracheobronchitis, laryngitis, and spasmodic croup is also excellent.