

Evaluation of Recent Updates Regarding Diagnosis and Management of Croup in Children

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Abstract

Background: All over the world, croup is a common upper respiratory infection of childhood, which is easily treated if recognized and assessed properly. Nevertheless, it can be severe enough to cause respiratory failure. This disease is actually considered one of the top causes of respiratory failure in children in some parts of the world. Viral Croup affects patients between 6 months to 6 years of age. In most of the cases, Parainfluenza virus is the most common cause of infection. **Objective:** This study aimed to discuss croup in terms of its etiology, pathogenesis, clinical features, diagnosis, assessment, and finally management. **Methods:** We searched PubMed for (((Croup) AND Etiology) OR Pathogenesis) OR Presentation) OR Management)). **Conclusion:** Croup is a common upper respiratory tract infection, which is usually viral in etiology. Most patients are in the young pediatric age group. It typically presents with stridor, cough, and hoarseness. Patients may present with a history of low-grade fever, but it is not necessary for diagnosis. Laboratory and imaging studies have no importance and no added value on the management plan outcomes. In the case of a suspected alternative diagnosis, diagnostic modalities may be used. The use of a single dose of dexamethasone improves symptoms. In case of moderate to severe symptoms, the addition of nebulized epinephrine improves symptoms and decreases the length of hospitalization.

Keywords: Croup, Diagnosis, Management

INTRODUCTION

Upper respiratory tract infections are common in both adult and pediatric populations with children being more affected than adults as indicated by most of the literature available [1-3]. Croup is one of the most prevalent typically viral upper respiratory tract infections that usually affects the younger pediatric age groups, mainly between 6 months to 6 years of age. In the United States, croup stands for 7% of hospitalized children for symptoms like fever and acute respiratory illness [4]. Unfortunately, not much data is available on this disease in the KSA in terms of its prevalence. In this paper, we addressed croup from the time of patient presentation, until she/he gets discharged.

In most cases, croup occurs as a result of viral infection, mainly parainfluenza virus which accounts for 75% of all cases. Other viruses may include, influenza A and B, adenovirus, respiratory syncytial virus, rhinovirus, and enterovirus [5]. In fewer cases, croup may result from a bacterial infection such as Mycoplasma pneumonia, and Corynebacterium diphtheriae. Most importantly, the cause of

infection does not have any effect on the outcome of the management plan [6].

Physicians should be able to diagnose and manage croup infection. Croup diagnosis is mainly clinical and diagnostic

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methods have no importance. This paper aimed at providing a simplified, yet comprehensive review for croup patients' diagnostic and management approaches.

METHODOLOGY

PubMed database was used for articles selection, and the following keywords were used in the MeSH ("Croup"[MeSH]) AND ("Croup management and diagnosis"[MeSH]). 30 papers were reviewed and included in the study. **Inclusion criteria:** The articles were selected based on the relevance to the project, which should include: Croup Diagnosis and Management. **Exclusion criteria:** All other articles that did not have a related aspect to the croup diagnosis and management as their primary endpoint or repeated studies.

DISCUSSION

Croup is a prevalent upper respiratory illness. The word "croup" can be found in the literature used to describe many pathological entities of upper respiratory tract infections, such as laryngitis, laryngotracheitis, bacterial tracheitis, and others. However, and to avoid confusion here, when we mention the word croup we are specifically referring to laryngotracheitis. Also, we shall use the definition formulated by Feigin and Cherry's Textbook of Pediatric Infectious Diseases. That is, croup is a respiratory viral infection that causes the upper respiratory tract and laryngeal mucosa to become edematous and inflamed, resulting in the subglottic narrowing [7].

Although the only paper we could find in the literature addressing the epidemiology of croup in Saudi Arabia was a paper published in 1998 and discussing the epidemiology of acute respiratory infections in 1429 hospitalized Saudi children [8], no clinician doubts that croup is a common respiratory infection in Saudi Arabia and the whole world. As an example, in Canada, over 80,000 children develop croup each year making it the second cause of respiratory distress in the second decade of life [9]. Boys are affected more than girls and the most common age group affected is children between 6 months and 3 years old [10].

Croup is an infection that typically has a viral etiology. The most common virus is parainfluenza virus type 1; especially in the epidemics that develop during the winter and fall seasons [11]. Parainfluenza viruses type 2 and 3 can also cause croup but they much less common and type 2 is the mildest and type 3 is the severest virus among the three types in terms of clinical manifestations [12]. Other viruses can cause croup as well, such as respiratory syncytial virus human coronavirus virus, measles, and others (see **Table 1**). Although croup being "viral" in etiology is a part of the definition we used, strictly speaking, this not always the case. The vast majority of croup cases are caused by viruses, but *Mycoplasma pneumoniae*, a bacterial pathogen, can cause the disease as well [13]. In addition, bacteria can lead to secondary infections. The most common bacteria to cause secondary infections in

croup are *Staphylococcus aureus*, *Streptococcus pyogenes* and *Streptococcus pneumoniae* [14-16].

Table 1: viral pathogens that can cause croup

Virus	Notes
Parainfluenza	Type 1 is the most common cause of croup, type 2 is the mildest, and 3 is the most severe type
Respiratory syncytial virus and adenoviruses	Not as common as parainfluenza in causing croup, but considered frequent causes. The lower airway component of the disease with these viruses is more significant than the laryngotracheal component.
Human coronavirus and measles	Important causes of croup where these viruses are prevalent.
Influenza virus	Not a common cause, but children admitted due to influenza virus croup tend to have longer hospitalization periods

Whatever the virus causing croup is, the disease pathogenesis is basically the same. The virus first infects the nasal and pharyngeal mucosa with secondary local spreading downwards across the respiratory mucosa. Once in the subglottic area, edema and inflammation will cause the subglottic airway to narrow producing the classic symptomatology of croup as will discussed later. This subglottic narrowing, which is the anatomical hallmark of croup, is due to the fact that the cricoid cartilage is a complete ring, unlike tracheal cartilage rings, which are horseshoe-shaped. In addition, the mucosa in children is floppy, which causes sort of a dynamic obstruction mechanism whenever the child cries or becomes agitated [10, 17].

Clinically, croup is characterized by the triad of inspiratory stridor, hoarseness, and cough. In children, barking cough is a clinical hallmark of the disease, while in adults, hoarseness is more common. In its most common form, which is laryngotracheitis due to the parainfluenza virus, the onset of the disease is insidious and its course is mild and self-limiting. It starts with nasal congestion and discharge, and progresses over around 2 days to fever, followed by the classic triad of cough, inspiratory stridor, and hoarseness. The cough typically resolves over three days, while the other symptoms may manifest for around a week [18]. Any deviation from this typical clinical presentation or course might prompt the treating physician to consider other diagnoses. When it is croup but the presentation is atypical a more severe disease is to be expected. Factors that might indicate a more severe disease are shown in (see **Table 2**).

Table 2: Factors that might indicate a more severe disease

Onset	Sudden rather than insidious
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Course	Rapid, with development of upper airway obstruction features over less than 12 hours.
History	Previous croup illness
Coexistent issue	In the form of underlying abnormality in the airway, or a medical condition that predisposes to respiratory failures such as neuromuscular disorders.

Once the diagnosis is made, which is a clinical one, the patient needs to be assessed for the proper management approach. Various scoring systems have been made for this purpose. The most famous one is the Westley Croup Score [19] (see **Table 3**), in which the severity of croup is determined by the presence or absence of stridor at rest, the mental status, the presence or absence of pallor or cyanosis, air entry, and the degree of chest wall retractions. Numbers are given to each of these five factors and depending on the total score, the disease will be classified under one of four categories of severity; mild, moderate, severe or impending respiratory failure. Finally, according to the category of severity the patient falls under, he/she will be managed. In general, the patient is treated at home if the disease is mild or moderate, while admission may be needed if the patient’s condition worsens. (see **Table 4**).

Management

The treating physician should evaluate the patient’s condition at the time of presentation. In case of hypoxemia or respiratory distress, oxygen should be administered. Corticosteroids should be used in the case of the severity of the disease. The use of steroids helps relieve symptoms [20]. Steroids help reduce edema in the laryngeal mucosa due to their anti-inflammatory properties. Russell *et al.* mentioned that the severity score reduced at 6 and 12 hours after the use of steroids with the reduction of staying time in ER and return visits [21]. In addition, they found that patients treated with steroids required lower doses of epinephrine. Fernandes *et al.* [22], discussed the safety of steroid use in children and found it to be safe in acute respiratory distress. Dexamethasone is superior to budesonide and prednisolone in the management of croup. Dexamethasone can be given as a single dose orally, intramuscularly, or intravenously. The most commonly used dose is 0.6 mg/kg [23]. Bjornson *et al.* discussed that the use of Epinephrine helps reduce and control symptoms. The use of Epinephrine causes arteriole vasoconstriction in the upper airway mucosa, which eventually leads to decreased edema. It is advised to use Epinephrine along with Dexamethasone due to its fast action, but it has a short half-life compared to Dexamethasone, which has a late onset of action but longer half-life. Epinephrine should be given at a dose of 0.05 mL per kg of racemic epinephrine 2.25% (maximum dose = 0.5 mL) or 0.5 mL per kg of L-epinephrine 1:1,000 via nebulizer (maximum dose = 5 mL) [24, 25].

Table 3: Westley croup severity score

Feature	Given score
Stridor	<ul style="list-style-type: none"> • None = 0 • With agitation = 1 • At rest = 2
Retractions	<ul style="list-style-type: none"> • None = 0 • Mild = 1 • Moderate = 2 • Severe = 3
Air entry	<ul style="list-style-type: none"> • Normal = 0 • Decreased = 1 • Markedly decreased = 2
Cyanosis	<ul style="list-style-type: none"> • None = 0 • With agitation = 4 • At rest = 5
Level of consciousness	<ul style="list-style-type: none"> • Normal, including sleep = 0 • Disoriented = 5

Table 4: Management approach using the Westley score

Score (Table 3)	Severity	Management
0 - 2	Mild	<ul style="list-style-type: none"> • Treat at home. • Symptomatic care including antipyretics, mist, and oral fluids. • Single dose of oral dexamethasone 0.15 to 0.6 mg/kg.
3 - 7	Moderate	<ul style="list-style-type: none"> • Treat at home. • Single dose of oral dexamethasone 0.6 mg/kg • Nebulized epinephrine • Admit if symptoms persist or worsen after the above treatment.
8 - 11	Severe	<ul style="list-style-type: none"> • In hospital management. • Single dose of oral/IM/IV dexamethasone 0.6 mg/kg. • Repeated doses of nebulized epinephrine may be needed.
12 or more	Impending respiratory failure	<ul style="list-style-type: none"> • In ICU management. • Single dose of IM/IV dexamethasone 0.6 mg/kg. • Repeated doses of nebulized epinephrine may be needed.

CONCLUSION

Croup is a prevalent upper respiratory tract infection. It typically has a viral etiology with parainfluenza virus type 1

being the most common, but bacterial etiology is possible. It usually affects children between the age of 6 months and 3 years and boys are affected more than girls. The usual presentation is with the clinical triad of stridor, cough, and hoarseness. These symptoms occur as a result of swelling of the larynx, trachea, and bronchi due to infection. Low-grade fever may occur, but it is not necessary for diagnosis. Laboratory studies are of no importance, viral culture and rapid antigens testing have no impact on the outcomes. Imaging studies should be done if epiglottitis or foreign body airway obstruction is suspected. Finally, the Westley Croups Score is commonly used for assessment and children are treated accordingly. Single dose of intravenous, intramuscular, or oral dexamethasone help relieve symptoms and reduce the length of hospitalization. In moderate to severe cases, nebulized epinephrine can be added.

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