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Clinical Guideline

Clinical Guideline on Management of Viral Croup

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Foreword

This Guideline had been developed by Quality Assurance Sub-committee, COC in Paediatrics and the expert authors for the Hospital Authority according to the state of medical knowledge at the time of publication. It has been established that doctors can act in accordance with a practice accepted as proper by a responsible body of medical opinion even though others may adopt a different practice. As such, this guideline is for general guidance only; the management of individual cases must be the clinical judgment and decision of the medical practitioners after considering all relevant circumstances, information and up-to-date medical knowledge. In view of the general nature of this guideline and the changes in medical science, the Hospital Authority, the Paediatric COC and the authors do not assume or accept any liability for this guideline.

Explanatory Notes on Level of Evidence and Grading System on Recommendation

The definition of types of evidence and grading recommendations originate from the US Agency for Health Care Policy and Research (AHCPR) and are also recommended and used by the Royal College of Paediatrics and Child Health.

Levels of evidence

Level	*Type of evidence (based on AHCPR 1992)*
Ia	Evidence obtained from meta-analysis of randomised controlled trials
Ib	Evidence obtained from at least one randomised controlled trial
IIa	Evidence obtained from at least one well-designed controlled study without randomisation
IIb	Evidence obtained from at least one other type of well-designed quasi-experimental study
III	Evidence obtained from well-designed non-experimental descriptive studies, such as comparative studies, correlation studies and case control studies
IV	Evidence obtained from expert committee reports or opinions and/or clinical experience of respected authorities

Grading of recommendations

Grade	*Type of recommendation (based on AHCPR 1994)*
A (Levels Ia, Ib)	Requires at least one randomised control trial as part of the body of literature of overall good quality and consistency addressing the specific recommendation
B (Levels IIa, IIb, III)	Requires availability of well-conducted clinical studies but no randomised clinical trials on the topic of recommendation
C (Level IV)	Requires evidence from expert committee reports or opinions and/or clinical experience of respected authorities. Indicates absence of directly applicable studies of good quality

Evidence is graded upon the methodological qualities. Guidelines normally contain many different recommendation based upon different levels of evidence. It is important that users are aware of the level of evidence on which each guideline recommendation is based. The link between guideline recommendation and the supporting evidence should be made explicit. Separating the strength of the recommendation from the level of evidence helps in situations where extrapolation is required to take the evidence of a methodologically strong study and apply it to the target population. Grading of recommendation in addition to level of evidence allow more flexibility for future revision. However, it is important to emphasis that the grading does not relate to the importance of the recommendation. Currently, there are discussions on taking account of relevant high quality non-RCTs and qualitative research and to incorporate them into appropriate grading system.

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Summary of recommendation

Recommendation

I. <u>The role of diagnostic laboratory test in Viral Croup</u>

1. Blood taking for complete blood picture is a painful procedure and should be avoided.
   (Level IV Evidence, Grade C Recommendation)
2. Arterial blood gas recommended only in very severe or intubated cases.
   (Level IV Evidence, Grade C Recommendation)
3. Lateral neck radiograph is not necessary in obvious case. Radiograph may be considered in stable patients with suspected foreign body or anatomical abnormalities.
   (Level IV Evidence, Grade C Recommendation)

II. <u>Monitoring of children with diagnosis of Viral Croup</u>

1. Hypoxaemia is an indication of respiratory compromise, monitoring of oxygen saturation is useful in moderate to severe cases.
   (Level III Evidence, Grade B Recommendation)
4. Respiratory rate, heart rate and conscious state are useful clinical parameters for monitoring of children with viral croup.
   (Level IV Evidence, Grade C Recommendation)
5. Pulsus paradoxus is a useful clinical parameter but is not recommended unless a non-invasive device is routinely available.
   (Level IIa Evidence, Grade B Recommendation)
6. Transcutaneous carbon dioxide pressure monitoring provide useful clinical parameter in severe cases.
   (Level III Evidence, Grade B Recommendation)
7. Scoring system for clinical severity is not necessary in routine clinical practice.
   (Level IV Evidence, Grade C Recommendation)

III. <u>Management of Viral Croup</u>

1. Corticosteroids is recommended for treatment of moderate to severe viral croup. A single dose of 0.6 mg/kg dexamethasone is recommended until more studies comparing a smaller dose are done. Oral administration is as effective as parenteral and is preferred because of its safety and efficacy.
   (Level I Evidence, Grade A Recommendation)
2. Nebulized budesonide (single dose 2 mg) is a reasonable alternative to oral or parenteral dexamethasone. In children with vomiting, neubilized budesonide or intravascular dexamethasone may be preferred.
   (Level Ib Evidence, Grade A Recommendation)
3. Nebulized adrenaline can be given as an initial treatment. However, it should not be used as the only treatment due to the possibility of relapse. Patient should not be discharged just based on the initial improvement.
   (Level Ib Evidence, Grade A Recommendation)

   It should be avoided in children with pre-existing cardiac disorder.
   (Level III Evidence, Grade C Recommendation)

IV. <u>Other supportive management</u>

1. Routine oxygen supplement is not necessary but it should be given if the child has progressive tachypnoea, tachycardia, cyanosis and laboured breathing.
   (Level IV Evidence, Grade C Recommendation)
2. Maintain hydration by encouraging oral fluid intake and intravenous fluid supplement in very distress child. Over-hydration should be avoided.
   (Level IV Evidence, Grade C Recommendation)
3. Intubation is rarely needed but act if necessary.
   (Level IV Evidence, Grade C Recommendation)
4. Routine chest physiotherapy is not recommended.
   (Level IV Evidence, Grade C Recommendation)
5. The use of humidified air is not recommended.
   (Level III Evidence, Grade B Recommendation)
6. Antibiotic is not recommended unless bacterial infection is clinically likely to be present.
   (Level IV Evidence, Grade C Recommendation)

Clinical Guideline on Management of Viral Croup

Introduction

Croup is an acute clinical syndrome typified by an acute onset of harsh barking cough, hoarseness, inspiratory stridor and respiratory distress.

Differential diagnoses include foreign body aspiration, bacterial tracheitis, acute epiglottitis and acute laryngotrachebronchitis or viral croup.

Viral croup usually starts with rhinorrhoea, sore throat, and mild fever for few days. The child then develops the characteristic barking cough, hoarseness, and inspiratory stridor, with or without the persistence of the low-grade fever. Symptoms tend to be worse at night but child is usually not acutely ill. Drooling is not common in viral croup. Parainfluence types 1, 2 & 3 are the most important infectious agents but others like influenza virus type A & B, respiratory syncytial virus, adenovirus, rhinovirus and enteroviruses are also common. In rare cases, herpes viruses and bacteria like Haemophilus influenza type B and Staphylococcus aureus had been isolated.

The incidence of viral croup peaks in the winter months. 91% of cases occur in less than 5 years of age with most cases occur before 2 years.[1] There is a slight male preponderance. In 1999, 0.81% of all children discharged from Hospital Authority hospitals in Hong Kong had the diagnosis of acute viral croup.[2]

Epiglottitis is a serious illness and is the most important differential diagnosis to exclude. However, it is less prevalent in Hong Kong. Most cases are preceded by upper respiratory tract symptoms but the onset of acute epiglottitis tends to be more abrupt and the child becomes ill quickly. There is associated high fever, irritability, restlessness and saliva drooling is prominent.

Bacterial tracheitis can be a complication of viral croup. The child usually develops high fever and looks toxic. However, its onset is usually not as abrupt as acute epiglottitis and there is a more typical barking cough. Drooling is not a feature in most cases.

Foreign body aspiration can usually be diagnosed from clinical history.

Croup can be diagnosed clinically in most cases. Throat examination is usually not necessary and must not be done in cases of suspected epiglottitis unless a skilled operator in intubation and emergency tracheostomy is available.

The objectives of this review are to evaluate the available evidences regarding:

i) The role of laboratory tests in viral croup
ii) The monitoring of children with diagnosis of viral croup
iii) The treatment options in viral croup

Methods for literature search are from 1) the MEDLINE and EMBASE databases from 1983 to 2000 using keywords – laryngotracheobronchitis, croup and 2) Cochrane Library databases for any meta-analyses and randomised control trials (RCT) in treatment of viral croup

The grading of evidence and recommendations are based on the definitions from the report – Standards for Development of Clinical Guidelines in Paediatrics and Child Health published by the Royal College of Paediatricians and Child Health 1998 and adopted by the Working Group on Clinical Guideline and Evidence Based Medicine.

I. The Role of Diagnostic Laboratory Test in Viral Croup

Any painful laboratory test should be avoided or kept to a minimum and reserved for those uncertain cases.

1) Complete Blood Picture

Complete blood picture will show mild leucocytosis and lymphocytosis but this is a very non-specific finding.

Evidence:	***It does not help the diagnosis and will not alter the management.***
	(Level IV)
Recommendation:	***Blood taking for complete blood picture is a painful procedure and should be avoided.***
	(Grade C)

2) Arterial Blood Gas

Arterial blood gases correlates well with the clinical severity and progression. Hypoxaemia is an earlier indicator of respiratory compromise and hypercapnia is a sensitive indicator of the severity of pulmonary disease. However this procedure is painful and the validity of the results obtained from an uncooperative and screaming child is questionable.

Evidence:	***The procedure is painful and the validity of the results from an agitating child is questionable.***
	(Level IV)
Recommendation:	***Recommended only in very severe or intubated cases.***
	(Grade C)

3) Lateral Neck Radiograph

Lateral neck X-ray film will show overdistension of hypopharynx and proximal larynx and the posteroanterior film will show the "steeple sign" due to the subglottic swelling. However most cases can be diagnosed on clinical ground and taking an X-ray may make the child more agitated.[3]

Evidence: ***Limited utility of lateral neck radiograph in diagnosing croup and have variable conclusions regarding their utility in diagnosing epiglottitis. The stress of the procedure may worsen the clinical course especially in acute epiglottitis.***
(Level IV)

Recommendation: ***Radiograph is not necessary in obvious case. Radiograph may be considered in stable patients with suspected foreign body or anatomical abnormalities.***
(Grade C)

II. Monitoring of Children with Diagnosis of Viral Croup

1) Pulse Oximetry

No RCT has been done to evaluate the clinical usefulness of pulse oximetry. However being a non-invasive monitoring method, it is useful in moderate to severe cases. [4,5]

Evidence: ***Most symptomatic children with croup will have normal findings on pulse oximetry and low oxygen saturation is uncommon except in severe cases.***
(Level III)

Recommendation: ***Hypoxaemia is an indication of respiratory compromise, monitoring of oxygen saturation is useful in moderate to severe cases.***
(Grade B)

2) Respiratory Rate

Tachypnoea correlates well with the severity of the disease but there is no study to look at the usefulness of this parameter in viral croup.
(Level IV)

3) Heart Rate

Tachycardia reflects hypoxaemia and acidosis.
(Level IV)

4) Conscious Level

This correlates well with the severity of the disease.
(Level IV)

Recommendation: ***Respiratory rate, heart rate and conscious state are useful clinical parameters for monitoring of children with viral croup.***
(Grade C)

5) Pulsus Paradoxus

A prospective blinded comparison study had found that this correlated well with the severity and improvement in croup.[6] However the device used in the study, a non-invasive continuous blood pressure and respiration monitoring device is not normally available for routine clinical use in Hong Kong. ***(Grade IIa)***

Recommendation: ***Pulsus paradoxus is a useful clinical parameter but is not recommended unless a non-invasive device is routinely available.***
(Grade B)

6) Transcutaneous Carbon Dioxide Pressure Monitoring

Hypercapnia is a late event in upper airway obstruction. A prospective study involving 17 children with severe croup had found that this correlated well with the severity of croup.[5]
(Level III)

Recommendation: ***Transcutaneous carbon dioxide pressure monitoring provide useful clinical parameter in severe cases.***
(Grade B)

7) Scoring System

A few scoring systems have been validated in clinical trials, e.g. Westley scoring system (Appendix II). There is, however, no clinical study to evaluate its usefulness in clinical practice. ***(Level IV)***

Recommendation: ***Scoring system for clinical severity is not necessary in routine clinical practice.***[7]
(Grade C)

III. Management of Viral Croup

Mild cases can be managed in A&E department or out patient clinic providing signs of deterioration can be watched out for – increasing stridor, increasing respiratory distress and increasing fatigue. ***(Level IV)***

Recommendation: ***A calm and warm environment, minimal disturbance together with parenteral comfort is all that needed in most cases of the mild croup.***
(Grade C)

1) In Children with Moderate to Severe Croup, is Steroid Therapy Effective in Reducing Acute Symptom?

- The argument of using corticosteroids in treating viral croup started in 1970s. However this question has been addressed by 2 meta-analyses.[8,9] The meta-analysis by Kairys et al included 9 RCT involving hospitalized cases (n=1286) and found significant improvement at 12 and 24 hours after steriod therapy. The other one by Ausejo et al included 24 RCTs (14 on in-patients and 10 on out-patients, n=1736) also favored steroid treatment (irrespective of the route of administration) in improving the croup score at 6 and 12 hours, reducing the need of adrenaline treatments, decreasing A&E attendance and hospital length of stay.
- Three RCTs[10-12] had shown that one single dose of oral or intramuscular steroids reduced croup score, hospital admission by 75% and re-attendance rate after discharge by 70%.
- One RCT[13] involving 120 children had shown that 0.15 mg/kg oral dexamethasone was as effective as 0.6 mg/kg. However those children on lower dose were more likely to receive nebulized adrenaline.
- One RCT with 277 children had found that with the same dosage, oral dexamethasone worked just as effective as parenteral route. And it was also much preferred by the patients and nursing staff.[14]

Evidence:
- ***Corticosteroids is effective in reducing acute symptoms in moderate to severe cases.***
(Level Ia)
- ***Oral administration is as effective as parenteral.***
(Level Ib)

Recommendation:
- ***Corticosteroids is recommended for treatment of moderate to severe viral croup.***
(Grade A)
- ***A single dose of 0.6 mg/kg dexamethasone is recommended until more studies comparing a smaller dose are done.***
(Grade A)
- ***Oral administration is as effective as parenteral and is preferred because of its safety and efficacy.***
(Grade A)

2) Is Nebulizer Steroid Therapy as Efficient as Systemic Steroid in Reducing Acute Symptoms?

- 4 RCTs[10,15-17] involving 250 children had shown that the nebulized budesonide compared with placebo halved the hospital admission rate.
- 2 RCTs[10,18] had shown no significant difference between systemic dexamethasone and a single dose of nebulized budesonide and the latter provided a faster onset of action.
- One pilot RCT[19] using inhaled fluticasone given through a spacer device had not demonstrated any benefit but this could probably be related to the small sample size and insufficient drug deposited in the upper airway.
- Systemic steroids were on the whole well tolerated in all trials. Three RCTs involving 130 children had reported a total of 13 cases of secondary bacterial infection.

Evidence: ***Nebulized budesonide at a single dose of 2 mg for all ages is a reasonable alternative to oral or parenteral dexamethasone for management of moderate to severe croup.***
(Level 1b)

Recommendation: ***In children with vomiting, nebulized budesonide or intramuscular dexamethasone may be preferred.***
(Grade A)

3) Nebulized Adrenaline

- There are 3 RCTs involving 53 children comparing nebulized racemic adrenaline with placebo.

Two showed no improvement.[20,21] One showed improvement within 30 minutes of treatment but effect could not be sustained and wore off after 2 hours.[7]

- One RCT showed that L-adrenaline was as effective as racemic adrenaline.[22]
- There was one case report of a child developed non-fatal myocardial infarction after treatment with nebulized adrenaline.[23]

Dosage:

0.05 ml/kg of 2.25% racemic adrenaline mixed with 2.5 ml normal saline
(Minimum dose 0.25 ml to maximum dose 0.75 ml)
or
0.5 ml/kg/dose 1:1,000 L-adrenaline added to 3 ml 0.9% NaCl solution
(Maximum dose: <4 years old – 2.5 ml, ≥4 years old – 5 ml)

Evidence: ***Nebulized adrenaline can provide temporary symptomatic relief before corticosteroids takes effect.***
(Level Ib)

Recommendation:
- ***Nebulized adrenaline can be given as an initial treatment. However, it should not be used as the only treatment due to the possibility of relapse. Patient should not be discharged just based on the initial improvement.***
(Grade A)
- ***It should be avoided in children with pre-existing cardiac disorder.***
(Grade B)

IV. Other Supportive Management

1) Oxygen

No RCT has been done to evaluate the use of oxygen but a child with moderate to severe upper airway obstruction may have a lower than expected oxygen saturation.[24]
(Level IV)

Recommendation: ***Routine oxygen supplement is not necessary but it should be given if the child has progressive tachypnoea, tachycardia, cyanosis and laboured breathing.*** ***(Grade C)***

2) Fluid

There is no study to evaluate the importance of hydration. However with the exaggerated negative intra-thoracic pressure due to the laryngeal obstruction, child is prone to develop pulmonary oedema. ***(Level IV)***

Recommendation: ***Maintain hydration by encouraging oral fluid intake and intravenous fluid supplement in very distress child. Over-hydration should be avoided.***
(Grade C)

3) Endotracheal Intubation

- Intubation is rarely required nowadays, as even the most distressed patient will respond to steroids and nebulized adrenaline. The decision to intubate is based on the clinical conditions and signs of deterioration.
- The size of the endotracheal tube with a diameter of 0.5 to 1 mm less than the predicted is recommended. The child should be kept intubated until there is air leak around the endotracheal tube.
(Level IV)

Recommendation: ***Intubation is rarely needed but act if necessary.***
(Grade C)

4) Chest Physiotherapy

No study has been done to evaluate this treatment but looking at the underlying pathology, it is unlikely to be useful as most of the obstruction is at the subglottic area. Physiotherapy may also aggravate the already distressed child. ***(Level IV)***

Recommendation: ***Routine chest physiotherapy is not recommended.***
(Grade C)

5) Humidified Air

- Mist therapy had been used for a long time to treat croup. There was only one RCT on this treatment which showed no statistical difference in the recovery rate.[25] The problem however with this study was that the sample population was small, only 16 children and it might not show any marginal benefit with this therapy.

- On the other hand, keeping an agitated child in a mist tent will undoubtedly aggravate the anxiety and making nursing observation difficult.
- In an animal model study, humidified air was shown to induce greater airway resistance than dry air.[26]

(Level III)

Recommendation: The use of humidified air is not recommended.

(Grade B)

6) Antibiotic

No RCT has been done but as virus is the most common etiologic agent in most cases, there is no place for antibiotic unless there is a strong reason to suspect a bacterial cause or if there is a secondary bacterial infection.

(Level IV)

Recommendation: Antibiotic is not recommended unless bacterial infection is clinically likely to be present.[27]

(Grade C)

Appendix II

Westley Croup Score[7]

Level of consciousness	
Normal	0
Disorientated	5
Cyanosis	
None	0
Cyanosis with agitation	4
Cyanosis at rest	5
Stridor	
None	0
When agitated	1
At rest	2
Air entry	
Normal	0
Decreased	1
Markedly decreased	2
Retractions	
None	0
Mild	1
Moderate	2
Severe	3

Maximum score is 17.

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