REVIEW

The assessment and management of croup

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INTRODUCTION

Croup or ‘laryngotracheobronchitis’ is a common problem in young children.1,2 Typically, it presents with a harsh, barking cough, and as proximal airway epithelial inflammation progresses, inspiratory stridor and signs of breathing difficulty supervene. The cough is distinctive and the diagnosis is usually easily appreciated. The narrowest section of the proximal airway is in the sub-glottic region and it is in this part of the upper airway where mucosal oedema will result in the marked reduction in cross-sectional area, manifesting with increased airway resistance and the resulting increased work of breathing in moderate to severe croup.1–3

The majority of children and their families need reassurance and little else, however, a significant subset of children require a short course of systemic (preferably oral) corticosteroids and period of observation in hospital.2,3 It appears to be acceptance of the use of corticosteroids for the treatment of croup over the last decade that has dramatically reduced the number of patients requiring admission to hospital and endotracheal intubation.1

However, there remains a lack of consensus on a consistent approach to the assessment and management of children with croup.3 This evidence-based review will include the Cochrane systematic review on glucocorticoids in croup (2004),4 reference to other studies, and the management of croup with particular consideration of the liberalisation of the use of corticosteroids for milder cases of croup. A standard description of the available evidence will be used in relation to treatment recommendations (Table 1).5

DEFINITION OF CROUP

Croup refers to the clinical syndrome of a hoarse voice, harsh barking cough and inspiratory stridor.1–3 The commonest cause of this symptom complex is viral laryngotracheobronchitis [LTB]. In line with common usage, the term croup will imply viral LTB. Commonly, preceding the development of the barking cough there will be a 1–4 day history of a coryzal illness (clear rhinorrhoea, low-grade temperature and possibly mild tachypnoea). Some patients lack a viral prodrome, particularly older children with a history of atopy, who are labelled as ‘spasmodic croup’.1,2 Both are treated similarly, with the emphasis being on the presenting symptoms and signs.1–3

KEYWORDS
laryngo-tracheobronchitis;
symptoms and signs of croup;
assessment of severity;
 systemic corticosteroids;
nebulised corticosteroids;
nebulised adrenaline

Summary
The treatment of croup has changed considerably over the last 25 years with the liberalisation of the use of systemic corticosteroids for mild to moderate croup. The administration of corticosteroids in croup has reduced the severity of the condition, dramatically reduced the need for endotracheal intubation, shortened the duration of intubation, reduced the length of hospital stay, reduced the need for hospital admission and reduced daycare/preschool absenteeism and improved sleep in milder cases. Despite studies showing the efficacy of nebulised and intramuscular corticosteroids, the use of oral corticosteroids remains the recommended option in most, if not all, cases of croup presenting for medical assessment.

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HOW COMMON IS CROUP?

Croup is the commonest cause of acute upper airway obstruction in young children. One study estimated that approximately 3% of children will have croup before the age of 6 years. Before the widespread use of corticosteroids, studies reported that as many as 31% patients with croup required hospitalisation, and 1.7% required endotracheal intubation. Data from the 1970s suggested that up to 6% of young children with croup will require hospitalisation, although estimates from the 1980s put the range at between 1.5 and 15%. The liberalisation of treatment with oral corticosteroids and nebulised adrenaline during the 1990s reduced the rate of hospitalisation further.

VIRUSES CAUSING CROUP

Viral infection of the upper airway results in inflammation of the pharynx, larynx, trachea and bronchi. However, it is evident that sub-glottic inflammation (swelling) compromises the airway in croup. A number of viruses may cause croup. The most common are the parainfluenza 1 and 3 and respiratory syncytial viruses. However, rhinovirus, adenovirus, measles virus and even *Mycoplasma pneumoniae* have been shown to cause croup. Parainfluenza viruses are responsible for the majority of croup, although one retrospective study has suggested that influenza viruses may be responsible for more severe cases, potentially resulting in more severe lower respiratory tract disease.

IS CROUP A SEASONAL CONDITION?

Although croup occurs throughout the year, the majority occurs with parainfluenza viral infections, typically in the autumn. Those with the respiratory syncytial virus present mainly in the winter. There is often a smaller spring peak.

DEMographics OF CHILDREN SUFFERING FROM CROUP

Croup usually affects children between 6 and 36 months old. It may occur in older children. Males are affected more commonly than females. The peak incidence is in the second year of life. A subset of children seems predisposed to recurrent croup.

VIRAL VERSUS SPASMODIC CROUP

The previous emphasis on distinguishing viral from spasmodic croup is of limited clinical value as it is the child’s degree of upper airway obstruction that will determine treatment rather than the sometimes erroneous sub-classification of its aetiology. Typically, viral croup develops over days with a concurrent coryzal illness; the symptoms disappear over 3–5 days. Conversely, spasmodic croup is said to be more common in atopic, older children and often becomes abruptly manifest overnight in children who were perfectly well when they went to bed. Spasmodic croup often runs a shorter clinical course, with symptoms abating in 24–48 h.

DIFFERENTIAL DIAGNOSIS

Although croup is a seemingly easy diagnosis in most children, there are occasions when alternative diagnoses should be considered. There are a number of structural and infective conditions that cause upper airway obstruction and may be categorised according to the anatomical site of airway narrowing (Table 2). These differential diagnoses are best considered in terms of the age of the child, the character of the stridor and the level of toxicity of the child.

Age of the child

- A child less than 3 months of age is more likely to have a structural airway problem (e.g., laryngomalacia) with or without an intercurrent viral infection. Similarly, tracheomalacia may present with a brassy cough and variable stridor, although is uncommonly recognised in such young infants largely because they may not generate sufficient airflow to make the noise apparent.
- A child between 3 months and 2 years of age may have variable stridor (perhaps biphasic stridor), a ‘to and fro’ wheeze and signs of tracheal tug and chest wall recession. These signs may pertain to tracheomalacia.
- A child between 1 and 3 years with the acute onset of respiratory difficulty without fever may have an inhaled foreign body (tracheal or oesophageal). Bronchial foreign bodies will usually have an associated localised expiratory wheeze (rather than inspiratory stridor).
may have evidence of air trapping on an expiratory chest radiograph below the level of obstruction (Ball-valve effect).

### Character of the stridor

The combination of inspiratory and expiratory stridor increases the likelihood of an underlying fixed tracheal obstruction such as sub-glottic stenosis or sub-acutely due to a retropharyngeal abscess after an upper respiratory tract infection or a penetrating pharyngeal wall injury. These patients need urgent assessment.

### Toxicity of the child

Children with croup do not appear toxic (pale, very febrile and poorly perfused). This is more commonly seen in bacterial tracheitis (usually *Staphylococcus aureus*), epiglottitis (*Haemophilus influenzae type B*) or viral ‘supraglottitis’.

### ASSESSMENT OF SEVERITY

Determining the degree of airway obstruction is the most important aspect of assessment. This relies upon an accurate history and on the delineation of the clinical signs. Because airway obstruction in croup can worsen rapidly, repeated careful clinical assessment is essential.\(^1\)\(^-\)\(^3\),\(^11\),\(^13\) The initial assessment should be made whilst taking the history. The child can be observed, preferably whilst seated on the parent’s lap at a non-threatening distance. Much information can be obtained without having to disturb the child. The respiratory rate can be assessed, as can the use of accessory muscles of respiration, tracheal tug and the presence (or absence) of central cyanosis. It is often helpful to ask the child’s parent to remove the child’s clothing covering the chest. This is less threatening to the child than a stranger doing so. In the assessment of the child, several aspects should be considered:

- General appearance: a child, who is agitated, appears to be tiring from the effort of breathing or has a decreasing level of consciousness needs to be closely monitored.
- Degree of respiratory distress: the presence of stridor at rest, tracheal tug, chest wall retractions, changing respiratory rate, and pulse rate indicate treatment is necessary.
- Cyanosis or extreme pallor indicates the need for immediate treatment.
- Oxygen desaturation as indicated by oximetry is a late sign and unreliable for croup severity.\(^14\) Oximetry reading is never a surrogate for clinical examination.

### TOOLS USED TO ASSESS CROUP SEVERITY

#### Oximetry

Oximetry is a routine tool used in the Emergency Department. Oximetry can never substitute a good clinical assessment. Oxygen saturation may be near normal in severe croup and yet significantly lowered in some children with mild to moderate disease.\(^14\) This apparent discrepancy may relate to the degree of lower airway disease present.

#### Clinical scoring systems

Croup severity scores have been used in hospital-based clinical research studies to assess the suitability of patients for treatment in a standardised manner.\(^15\),\(^16\) The most widely used scoring system was that reported by Westley and colleagues in 1984.\(^15\) This gives a cumulative croup score, grading for the degree of stridor, retractions, air entry, cyanosis, dyspnœa and level of consciousness (Table 3). However, whilst extremely important in research studies, croup scores are of limited value in clinical practice unless the medical and nursing staff lack experience (Table 4).

#### Lateral airways radiograph

This should not be undertaken as croup is a clinical diagnosis and no additional information in the management
of croup can be gleaned from the X-ray.\textsuperscript{1} In the presence of severe obstruction, the child may become more agitated and the degree of obstruction rapidly increases in an area with limited facilities for immediate treatment.\textsuperscript{2} Where there is doubt about the diagnosis, or it is severe and not responding to standard treatment, it is prudent to proceed to bronchoscopy in a controlled manner after an inhalation anaesthetic in the operating theatre.\textsuperscript{1,2,11}

Chest radiograph

A chest X-ray is not indicated in the management of children with uncomplicated croup.\textsuperscript{1,11} However, rarely a chest X-ray may be considered where there is uncertainty about the diagnosis because of additional findings (e.g., wheeze raising the possibility of croup/asthma, crackles raising the possibility of a chest infection or differential air entry suggesting an inhaled foreign body).\textsuperscript{1,2}

**STRATIFICATION OF CROUP SEVERITY**

Croup may be classified into mild, moderate and severe, which will guide the degree of intervention required.\textsuperscript{1} Croup involves dynamic airway obstruction and so the symptoms can be viewed as part of a continuum.\textsuperscript{1,2,11} Indeed, the degree of severity may change rapidly both in terms of deterioration and improvement in response to therapy. The need for regular review and explanation cannot be emphasised too strongly in children admitted to hospital for treatment, particularly with their first episode as the parents will be unfamiliar with the expectations of the natural history of the condition or response time to therapy (e.g., nebulised adrenaline versus oral corticosteroids).\textsuperscript{2} The grades of severity are outlined below and summarised in Table 5.\textsuperscript{1}

### Mild airway obstruction

This can be assumed when the child appears happy and is prepared to drink, eat, play and take an interest in the surroundings. There may be mild chest wall retractions and mild tachycardia but stridor at rest will not be present. Pharmacological treatment with a single dose of oral corticosteroid is optional but increasingly recommended [E2-4]. The parents should be reassured, given an explanation of what to expect over the coming days and be provided with an information fact sheet.

### Progression from mild to moderate airway obstruction

This may occur quickly or gradually over hours. Typically, a child with a harsh, barking cough will develop intermittent stridor when agitated and then intermittent stridor at rest before progressing to persisting stridor at rest. In this situation the child has progressed probably from conservative treatment to pharmacological treatment and a period of observation.

<table>
<thead>
<tr>
<th>Table 3</th>
<th>Westley croup score.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptom</td>
<td>Descriptor</td>
</tr>
<tr>
<td>Stridor</td>
<td>None</td>
</tr>
<tr>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td>When agitated</td>
<td>1</td>
</tr>
<tr>
<td>At rest</td>
<td>2</td>
</tr>
<tr>
<td>Retractions</td>
<td>Mild</td>
</tr>
<tr>
<td>None</td>
<td>0</td>
</tr>
<tr>
<td>Moderate</td>
<td>2</td>
</tr>
<tr>
<td>Severe</td>
<td>3</td>
</tr>
<tr>
<td>Air Entry</td>
<td>Normal</td>
</tr>
<tr>
<td>Decreased</td>
<td>1</td>
</tr>
<tr>
<td>Markedly decreased</td>
<td>2</td>
</tr>
<tr>
<td>Cyanosis in room air</td>
<td>None</td>
</tr>
<tr>
<td>With agitation</td>
<td>4</td>
</tr>
<tr>
<td>At rest</td>
<td>5</td>
</tr>
<tr>
<td>Level of consciousness</td>
<td>Normal</td>
</tr>
<tr>
<td>Disoriented</td>
<td>5</td>
</tr>
<tr>
<td>Total score</td>
<td>0–17</td>
</tr>
</tbody>
</table>

| Mild croup: scores 1–2; Moderate croup: scores 3–8; Severe croup: scores > 8. |

### Table 4  Factors increasing the likelihood of hospitalisation.

Factors increasing the likelihood of hospital admission [E4]:
1. History of severe obstruction before presentation
2. History of previous severe croup or known structural airway anomaly (e.g., subglottic stenosis)
3. Age less than 6 months
4. Degree of respiratory distress (stridor at rest = observation or admission)
5. Inadequate fluid intake
6. Parental anxiety
7. Proximity of home to the hospital/transport issues
8. Late evening or night-time presentation
9. Representation to the Emergency Department within 24 h of discharge
10. Poor response to initial treatment
11. Uncertain diagnosis.

Derived from Fitzgerald DA, Kilham HA (2003).\textsuperscript{1}
Moderate airway obstruction
This is indicated by persisting stridor at rest, chest wall retractions, use of the accessory muscles of respiration and increasing heart rate. The child can be placated and is interactive with people and surroundings. The child will need systemic corticosteroids and observation for a minimum of 4 h. If the child continues to have stridor at rest, then further treatment will be considered with prolonged observation in the emergency department or admission to hospital.

Progression from moderate to severe obstruction
The child may begin to appear worried, preoccupied or tired and may sleep for short periods. This child will require close, continuing observation in the emergency department or hospital, treatment with systemic corticosteroids and nebulised adrenaline with regular (minimum every 30–60 min) clinical review. Progression of signs will indicate the need for medical reassessment and consideration of further treatment with systemic corticosteroids and nebulised adrenaline. The child must be admitted to hospital.

Severe airway obstruction
As airway obstruction increases, the appearance will be that of increasing tiredness and exhaustion. Marked tachycardia is usually present. Restlessness, agitation, irrational behaviour, decreased conscious level, hypotonia, cyanosis and marked pallor are late signs indicating that dangerous airway obstruction is now present. The child should not be unnecessarily disturbed other than the immediate application of mask oxygen with further nebulised adrenaline as preparations are made to intubate the child by someone skilled in paediatric intubation (ideally with an inhalational induction). Systemic steroids, if not previously given, will be administered once the airway is secured\[E4\].

DOES ANYBODY EVER DIE FROM CROUP IN THE 21ST CENTURY?
Yes. Deaths from croup were not uncommon until the 1960s.\[E4\] Over the last 40 years with the rise of paediatric intensive care, the more liberal use of systemic corticosteroids and nebulised adrenaline by both ambulance officers and in the hospital setting, the rate of death has fallen \[E3, E4\]. Fallen but not ameliorated completely, especially in younger children. This was highlighted in the reporting of two such children, aged 9.5 months and 2 years, who were initially assessed and treated appropriately with oral corticosteroids by experienced paediatricians before their airway obstruction progressed rapidly, prompting out-of-hospital cardiopulmonary arrests and subsequent deaths from hypoxic ischaemic encephalopathy. 17

TREATMENT
The most important change in the management of croup has been the earlier and more liberal use of systemic and nebulised corticosteroids and nebulised adrenaline 23 in the Emergency Department. Much work has focussed on steroid treatment in the hospital setting and its use can be seen in the levels of evidence (Table 1) available to ascertain its effectiveness. Recent work has shifted the emphasis on treatment with oral corticosteroids to the primary care setting where there is an emphasis on earlier intervention to prevent progression to the need for hospitalisation.

EVIDENCE-BASED TREATMENT OPTIONS
Non-pharmacological
Steam inhalation
The use of steam inhalations for the treatment of croup has been advocated since the nineteenth century to ‘break the coughing spasm’ 9. However, steam inhalation has not been...
scientifically validated. Those who advocate steam inhalations do so on the basis of historical charm rather than scientific rigour [E4]. Indeed, only two studies have attempted to evaluate the use of humidified air to treat croup and both were unable to find evidence to support the use of steam in croup. One was an underpowered, randomised, controlled trial involving 16 patients with croup randomised to room air or a humidified atmosphere for 12 h in hospital [E3]. The second involved only seven subjects who showed no improvement in respiratory resistance when measured after the administration of 2 ml nebulised sterile water [E3].

More recent double-blind, randomised, controlled trial in children aged 3 months to 6 years with moderately severe croup (n = 71) showed no benefit from mist (humidified air) therapy when given in addition to oral dexamethasone (0.6 mg/kg, given to all patients) in terms of croup score, oxygen saturation, heart rate or respiratory rate over 2 h [E2]. It is worthy of note that the use of steamed up bathrooms from hot water running into baths, basins and showers for croup continues to be associated with entirely preventable scalds and burns in young children [E3].

**Ice masks**

This is a therapy that is restricted to some parts of the world where it is believed to be efficacious. However, there is no evidence from randomised, controlled trials to support ice masks and their use remains based on local recommendations [E4].

**Oxygen**

Oxygen is the immediate treatment of choice for children with severe viral croup who have considerable upper airway obstruction with significant oxygen desaturation (SaO2 < 90%) [E4]. This therapy has not been subjected to a randomised, controlled trial and is unlikely ever to be. It is the initial treatment before the administration of pharmacological treatment in the hospital setting.

**Pharmacological**

**Corticosteroids**

The precise mechanism by which corticosteroids exert their effect is not known. It is presumed to be on the basis of rapidly acting anti-inflammatory properties or vasoconstrictive actions in the upper airway. As outlined in the most recent update of the Cochrane review on glucocorticoids in croup, corticosteroids are effective in reducing symptoms of rapidly acting anti-inflammatory properties or vasoconstrictive actions in the upper airway. As outlined in the most recent update of the Cochrane review on glucocorticoids [E3], lower doses of oral dexamethasone (0.15 mg/kg and 0.30 mg/kg) have been shown to be almost as efficacious as the standard dose of 0.6 mg/kg [E3]. Lower doses of oral dexamethasone (0.15 mg/kg and 0.30 mg/kg) have been shown to be almost as efficacious as the standard dose of 0.6 mg/kg [E3].

A commonly used alternative to dexamethasone is the use of prednisolone. Prednisolone has been compared favourably with a placebo in three trials [E3]. Lower doses of oral dexamethasone (0.15 mg/kg and 0.30 mg/kg) have been shown to be almost as efficacious as the standard dose of 0.6 mg/kg [E3]. In clinical practice, most clinicians are encouraged to initially prescribe oral corticosteroids because they are inexpensive, easy to administer and readily available [E3]. For simplicity, the recommended dose of dexamethasone is 0.6 mg/kg (maximum 8 mg) or prednisolone is 1 mg/kg (maximum 50 mg) [E4].

**Nebulised corticosteroids**

The use of 2 mg nebulised budesonide to treat croup attracted attention during the 1990s and has been shown to be efficacious in treating croup [E3]. It has an action of onset with onset of 30 min [E3], which compares favourably with systemically administered corticosteroids that have an effect within 1 h [E2]. The onset of action of nebulised budesonide is slower than nebulised adrenaline but faster than systemic corticosteroids [E3]. However, defining the role of nebulised corticosteroids in the treatment of acute viral croup has prompted a number of recent studies in which its role as an alternative to or an additive therapy to systemic corticosteroids has been evaluated. The best of these studies, by Geelhoed and MacDonald (1995) showed that both were superior to the placebo but that oral dexamethasone was superior to nebulised budesonide. Further, another study demonstrated no difference in Westley croup scores at 6 h whether nebulised budesonide or oral dexamethasone was used.

**Nebulised adrenaline**

A child with persisting inspiratory stridor at rest and marked chest wall retractions has severe croup. Such a child need not be centrally cyanosed to be severely obstructed and should receive immediate treatment with nebulised L-adrenaline (1:1000 concentration at a dose of 0.5 ml/kg of body weight to a maximum dose of 5 ml delivered neat in the nebuliser bowl) or 2.25% racemic.
adrenaline 0.5 ml diluted in normal saline. This dose should be administered whilst awaiting the arrival of the ambulance for transfer to hospital. In addition to the adrenaline, a dose of oral corticosteroid (dexamethasone or prednisone) should be administered. The child should be reassessed regularly. It has been suggested that nebulised adrenaline reduces bronchial and tracheal epithelial vascular permeability thereby decreasing airway oedema, which results in an increase in the airway radius and improved airflow \(^4,10\) \([E4]\). The standard dose of L-adrenaline is 5 ml of 1:1000 adrenaline delivered neat in a nebuliser bowl is for a 10 kg child. Smaller children have a dose of 0.5 ml of 1:1000 adrenaline per kilogram of body weight up to a maximum dose of 5 ml \(^1,10\) \([E1]\). The onset of action is clinically rapid with double-blinded, randomised, controlled trials documenting a fall in croup symptom scores within 30 min \(^0,18,21\) \([E2]\). The duration of effect is approximately 2 h \(^4,14\) \([E2]\). However, with more severe croup, the same dose may need to be repeated. \(^1\) The need for several doses of nebulised adrenaline in a short period of time indicates the need to consider urgent transfer to a paediatric centre and/or the need for intubation \(^4\) \([E4]\). The use of nebulised adrenaline is relatively contraindicated in children with ventricular outflow tract obstruction (e.g., tetralogy of Fallot).

**Racemic adrenaline versus L-adrenaline**

L-adrenaline is the biologically active isomer of adrenaline but for historical reasons, the use of racemic adrenaline has been promulgated in certain countries (e.g., USA and Canada) and yet never recommended in others (e.g., Australia). As L-adrenaline is more widely available and less expensive than racemic adrenaline, it is surprising that only two studies compared the two adrenaline preparations in croup. \(^31,32\) There was no significant difference in croup scores, respiratory rates, heart rates nor blood pressures with either preparation used in equal doses \(^31,32\) \([E2]\).

**What is the role of Heliox in relation to adrenaline in the intensive care setting?**

Helium, an inert, non-flammable gas with no known direct pharmacological effects, is one seventh the density of air. \(^33\) Moreover, carbon dioxide diffuses through helium four to five times faster than through air. \(^33\) By its lower density, a helium and oxygen mixture (e.g., Heliox 80:20 or 70:30) improves gas flow through high resistance airways in which gas flow is turbulent. This is useful in conditions with turbulent airflow such as a severe croup, bronchiolitis and asthma in the intensive care setting where respiratory failure is progressing to the point where mechanical ventilation is imminent. A recent study compared the use of Heliox [70:30] with racemic adrenaline in a double-blind, randomised, controlled trial in 29 children who were receiving humidified oxygen and systemic corticosteroids. \(^34\) This small study concluded that the treatments resulted in similar benefits \([E2]\). However, with the availability and ease of administration of adrenaline, one would presumably consider the use of adrenaline in preference to heliox in most clinical settings. \(^35\)

**Liberalised use of corticosteroids in mild croup**

Although many primary care physicians and emergency department clinicians may prescribe a single dose of oral corticosteroids for mild croup, the first substantive evidence to support this approach was provided in the 2004 study of Bjornson and colleagues reporting on the use of a single dose of oral dexamethasone (0.6 mg/kg) provided in the emergency department setting \(^36\) \([E2]\). In this well-designed, double-blind, randomised, placebo-controlled trial in 720 children with a croup Westley score of 2, they showed benefits in terms of improved sleep duration for the children over the first three nights (30% better with dexamethasone) and some potential modest health economic savings over the subsequent 21 days after presentation, including a 50% reduction in the number of return visits to a healthcare provider for those who received dexamethasone.

**FREQUENTLY ASKED CLINICAL QUESTIONS**

**Is there a Cochrane review on the role of glucocorticoids for the treatment of croup?**

The original review was published in 1997 and most recently updated in 2004. \(^4\) The conclusions were generally consistent with the meta-analysis of Kairys et al. (1989) \(^8\) and Ausejo et al. (1999), \(^37\) finding systemic steroids to be advantageous in reducing the severity of moderate to severe croup. What the Cochrane review adds is further evidence for the use of systemic steroids in milder cases of croup, specifically that the time spent in an emergency department was reduced (weighted mean difference 12 h, 5–19 h) and the likelihood of a patient with croup representing with croup is reduced by 50% with the use of systemic corticosteroids [relative risk 0.50; confidence interval (CI): 0.36 to 0.70] \(^1\) \([E1]\).

**How long does stridor at rest persist after the administration of oral prednisolone?**

A recent retrospective trial considered this question and determined that, in 188 children admitted to a district community hospital in the UK, the mean duration of stridor at rest was 6.5 h (95% CI 6.7 h; range 0.5–82 h) after a single dose of prednisolone (1 mg/kg). \(^38\) The authors rightly concluded that this may allow the earlier discharge of patients with milder croup from the emergency department rather than the wards. \(^38\) \([E3]\).
Is oral dexamethasone more efficacious than oral prednisolone?

This question was posed in 2003 and despite 139 studies employing dexamethasone or prednisolone in the treatment of croup, there have been no direct comparisons. The half life of dexamethasone is approximately double that of prednisolone. As there is no evidence to favour one treatment over the other, local practice advice should be followed [E4].

Nebulised versus oral versus intramuscular corticosteroids

A recently published study from Turkey provided some insight into whether the mode of delivery of a single dose of systemic corticosteroid (oral or intramuscular dexamethasone at 0.6 mg/kg up to 8 mg) or nebulised corticosteroid (budesonide 500 μg) hastened recovery over 72 h when compared with placebo in a group of 60 children. Notwithstanding some limitations in the study design, the study showed that each steroid treatment (15 patients in each group) resulted in a similar improvement in children aged 6–36 months with mild croup (Westley score of 2–3) over 3 days and that each mode was superior to placebo [E3]. Interestingly, this was a lower dose of nebulised budesonide than had been used in several previous studies (500 μg versus up to 2000 μg). The authors concluded that, in mild croup, the mode of delivery of the steroid does not influence the outcome but were superior to placebo in improving croup scores [E1].

Should all children with croup receive a single dose of oral corticosteroids?

Although there is no question that all children with moderate to severe croup should receive at least a single dose of oral corticosteroid, the question of whether children with mild croup warrant treatment with oral corticosteroids is becoming clearer. The first study of systemic corticosteroids for the outpatient management of croup of moderate severity (intramuscular dexamethasone versus intramuscular saline for moderate croup) was published by Cruz et al. [1995]. It demonstrated an improvement in clinical symptoms of croup in a telephone interview 24 h later. More recently, the study of Bjornson et al. extended the use of dexamethasone at 0.6 mg/kg by mouth to children with mild croup and showed that symptoms improved faster, less sleep was lost by children, less stress was experienced by parents, and fewer children returned to medical care during the same croup illness in the dexamethasone treated children. The authors concluded that, although the long-term effects of this treatment are not known, their data supported the use of oral dexamethasone in most, if not all, children with croup.

Consequently, many clinicians would favour the use of a single dose of oral corticosteroid for all children presenting with croup and recent review articles are supportive of this position [1,3,35,42,43].

PRACTICE POINTS

- Mild croup does not always need pharmacological treatment, but increasingly clinicians are using a single dose of oral corticosteroids in this primary care setting [E4].
- There is no RCT evidence to support the use of mist therapy [E3].
- Children with croup who demonstrate stridor and chest wall retractions should receive corticosteroids [E4].
- Although oral, intravenous, intramuscular and nebulised corticosteroids are efficacious, the use of oral corticosteroids is kindest to the patient, easy to administer and inexpensive [E1].
- The treatment of moderately severe croup will usually involve the use of nebulised adrenaline and systemic corticosteroids [E2].
- The need for transfer to a paediatric centre is based upon age of the child, presence of predisposing conditions (e.g., sub-glottic stenosis) and severity of the illness, response to treatment and level of expertise available at the hospital [E4].
- A child with an unstable airway/severe croup will require a medical escort for transfer to a centre with paediatric supervision [E4].

FUTURE RESEARCH

- Directly compare the efficacy of a single dose of oral dexamethasone with a single dose of prednisolone for children with mild to moderately severe croup.
- Improve the standardisation of care of croup by better dissemination of the evidence for the pharmacologic treatment of croup within medical and nursing communities.
- Better define the optimal dose of dexamethasone for mild to moderate croup in the primary care setting.

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