Airway Management in Acute Infectious Croup Syndromes

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The article presents the author's experience with airway management of 500 children with acute infectious croup and epiglottitis over a 7-year period in a teaching hospital setup. A policy of early elective protective intubation under controlled condition for children with severe croup and epiglottitis, in a multidisciplinary intensive care setting resulted in a satisfactory outcome. Recent developments in the field are discussed; these include non-invasive monitoring, medical treatment options for viral croup with parenteral high dose dexamethasone and nebulized adrenaline, newer broad-spectrum antimicrobials for drug-resistant bacterial infectious and an effective vaccine against Hemophilus influenzae type b. These hold the promise of reducing morbidity and mortality from acute infectious croup syndromes even in situations with limited surgical and monitoring facilities.

INTRODUCTION

'Croup' refers to a syndrome of barking or 'croupy' cough associated with stridor. Acute croup syndromes are a common cause of referral to otolaryngologists and pediatricians. Despite ongoing advances in their management, they remain a cause for concern because of continuing preventable mortality and sequelae from hypoxic brain damage secondary to upper airway obstruction (UAO).

This article presents the author's experience with airway management in acute infectious croup and epiglottitis in a teaching hospital setting and highlights some recent developments on the subject.

PATIENTS AND METHODS

The management of croup upto the seventies focussed on conservative treatment with late airway intervention. In this earlier era, there were 195 patients with croup and epiglottitis treated over a 7-year period at Royal Aberdeen Children's Hospital, U.K.. Tracheostomy was done in 12 of 183 children (6.6%) with presumed viral croup and 9 of 12 (75%) with epiglottitis. Five of the 12 patients with epiglottitis died, two of whom succumbed after late tracheostomy in moribund patients. This poor outcome, along with a better understanding of the nature of epiglottitis and severe croup and advances in intensive care led to a reassessment and revision of management approach in the eighties.

The revised policy entailed a more aggressive approach being followed for children with suspected epiglottitis and severe croup. The hallmarks of this policy were : a) multidisciplinary approach with involvement of pediatrician, otolaryngologist and anesthetist, b) continuous monitoring in an intensive care setting and c) priority given to protecting the airway to prevent hypoxic brain damage. Better anesthetic expertise with endotracheal intubations led to this method being preferred to tracheostomy in these children with transient, self-limited forms of UAO.

Investigations used in these patients, as indicated, included blood and epiglottic cultures, arterial blood gases (ABG), and x-rays of the chest and neck. Investigation was, however, deferred in critically ill patients in order to avoid undue intubation delay. Initial antibiotics for epiglottitis were a combination of IV ampicillin and

chloramphenicol; subsequent chemotherapy was dictated by the clinical response and results of culture and sensitivity tests. Cool mist was used in all patients.

RESULTS

Of 500 children with acute croup and epiglottitis who were admitted and treated with this new protocol over a 7-year period, there was male-female ratio of 2.2:1 and 32 children required intubation. All 9 children with *Hemophilus influenzae* type b (Hib) epiglottitis were intubated, whereas the intubation rate in patients with presumed viral croup was 4.7% (23 of 491). Twenty seven of the 32 (85%) patients were intubated within 4 hours of admission, 14 of them within the first hour. No patient require tracheostomy. Though there were no intubation failures, there were potentially serious intubation-related problems in some patients. These included difficulty with initial intubation ($n = 2$), vomiting/aspiration during the procedure ($n = 7$), requirement for reintubation (total = 10; 2 after spontaneous extubation, 5 following elective extubation and 3 to replace an obstructed tube). Blockage of the tube occurred in 6 patients; this was treated by vigorous suction in 2 patients, emergency reintubation in 3 patients and successful extubation in the remaining patient. Fifteen patients required sedation during the period of intubation. All patients in the cohort recovered without sequelae.

Table I lists the features which helped differentiate the group of patients with severe croup and epiglottitis selected for intubation from the milder group who were treated conservatively. A comparison of clinical features in the two sub-groups of intubated patients (i.e. severe croup vs epiglottitis) showed considerable clinical overlap with no features which could be considered as diagnostic of either sub-group.

DISCUSSION

Acute upper airway obstruction (UAO) is an important pediatric and ENT emergency where

Table I

Comparison of differentiating clinical features of intubated and non-intubated children with infectious croup syndromes

Feature	Intubated group (n=32)	Non-intubated group (n=468)
Respiratory distress	100%	52%
Colour change : pallor, cyanosis	56%	0
Drooling, dysphagia	31%	3%
'Toxic' appearance	53%	2%

optimal and timely management is often crucial to the outcome. The small caliber of the upper airway in infants and young children makes this a vulnerable age-group for UAO from a variety

Table II

Causes of acute stridor in children

Infective	Non-infective
Viral Laryngotracheitis	Foreign body Spasmodic croup
Bacterial Epiglottitis Tracheitis Diphtheria	Angio-edema larynx Trauma
Abscess Peritonsillar Retropharyngeal	Tetany Acute on chronic stridor

of causes.¹ The major causes of acute stridor in children are listed in table II.

A good history and physical examination are important in arriving at an initial clinical impression of the likely cause, which will determine further investigations and management. Viral croup accounts for about 90% of children with acute febrile stridor¹. Because of its rapidly progressive, potentially lethal course, epiglottitis would constitute the most important differential diagnosis of severe febrile croup. The success of the universal immunization

programme should not lead to complacency about diphtheria, which needs to be excluded by an immunization history and search for the characteristic membrane. A history of choking and foreign body (FB) aspiration should be sought in every case.

Though epiglottitis can often be suspected on the basis of a classical presentation, our experience suggests that it cannot be reliably differentiated from severe croup on purely clinical grounds, as some features such as drooling and respiratory distress, are present in all patients with critical UAO regardless of the cause. It would be prudent, therefore, where facilities are available, to plan for direct visualisation of the larynx under controlled conditions in all patients presenting with severe stridor. The findings at laryngoscopy (and/or bronchoscopy) will help in the differentiation of various entities such as epiglottitis, viral croup, bacterial tracheitis and FB and further management tailed accordingly.

Certain practical 'do's and 'don't's with reference to examination and treatment of children with UAO require emphasising on any discussion of the subject.

Any reduction in airway size and increase of airflow turbulence exponentially increases airway resistance and work of breathing². It is, therefore, important to keep the child with UAO as calm and quiet as possible, preferably in the mother's lap in the 'position of comfort' and to avoid unnecessary interventions. Oxygen or humidity should be provided in a non-threatening manner¹. The Heimlich manoeuvre of abdominal thrusts is contra-indicated in infants and should be used as a resuscitative measure in older children only when there is acute, complete UAO from FB aspiration which has been witnessed or is strongly suspected³. Forceful attempts at depressing the tongue to visualise the pharynx should be avoided in children with severe stridor as the manoeuvre may precipitate complete obstruction and cardiorespiratory arrest, particularly in epiglottitis¹. A 'crash' intubation under poorly controlled conditions might prove

disastrous in these patients with anticipated intubation difficulty on account of distorted and narrowed airways. The procedure should be performed semi electively in a controlled environment in the operating room by an experienced anaesthetist using an endotracheal tube of 1 mm size smaller than one normally used for that age. An otolaryngologist should be part of the team standing by for emergency bronchoscopy or for tracheostomy in the event of a failed intubation. Tracheostomy may be preferred method of airway protection in some settings.

ABGs show hypoxemia and hypocarbia from hyperventilation in the early stages and increasing pCO₂ and respiratory acidosis in the late stage of UAO. X-rays may reveal a swollen epiglottis ('thumb' sign), subglottic stenosis ('steeple' sign) or a radio-opaque FB. However, these investigations have limitations in terms of their availability, performance or interpretation⁴. These invasive procedures may contribute to mortality in a critically obstructed child by increasingly patient discomfort and causing delay in institution of definitive airway protective measures. These problems in investigating such patients has led to the use of clinical scoring systems, an example of which is given in table III¹.

Recent developments in the past decade in the field of acute infectious croup syndromes are discussed in the hope that it can contribute to improved airway management and outcome and may be applicable even in settings with limited facilities.

Pulse oximetry represents a major advance in non-invasive monitoring of these patients that is now increasingly available in India.

Bacterial tracheitis has become recognised as an entity causing severe morbidity in young children. This usually occurs secondary to a viral laryngotracheitis and the causative organism is usually the staphylococcus. The diagnosis is suspected in a patient with presumed viral croup who deteriorates with high fever, increasing stridor and distress. Laryngo/bronchoscopy shows

Table III.
Clinical croup score*

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

*A score of 4 or more indicates moderately severe airway obstruction. A score of 7 or more, particularly when associated with Pa CO₂ > 45 and PaO₂ < 70 (in room air), indicates impending respiratory failure.

profuse purulent secretions welling up from the trachea and a subglottic pseudomembrane. X-rays reveal a ragged tracheal silhouette. Management consists of broad-spectrum antibiotic therapy including antistaphylococcal cover and, often, intubation or tracheostomy for better tracheal toilet.

Steroids and epinephrine have been reported to reduce the need for initial intubation and for reintubation after extubation in patients with moderate to severe croup (but not epiglottitis)⁵⁻⁸. Dexamethasone 0.6mg/kg IM or IV, administered as soon as possible, has been shown to prevent progression to complete obstruction and to shorten the duration of the illness, both in the emergency room and inpatient setting⁵⁻⁶. Nebulised L-epinephrine (adrenaline), which is readily available, has been found to be as effective and safe as the racemic form (which is not available in India)⁸. 1 in 1000 adrenaline 0.5 ml is diluted to 5 ml with normal saline and given through a nebuliser¹. However, as with racemic epinephrine, the effect is transient and the patient must be observed for at least 4 hours for a rebound. The metabisulphite preservative used in adrenaline solutions has been reported to induce bronchospasm in patients with hyper-reactive airways⁹. These agents appear particularly promising for hospitals with limited surgical and monitoring facilities as they greatly reduce or eliminate the need for intubation. In patients with suspected epiglottitis, however, the

safest option is proceed to elective laryngoscopy and intubation without wasting time with trials of medical management.

Emergence of resistance to chloramphenicol and ampicillin have lead to the use of newer broad-spectrum antimicrobials such as third-generation cephalosporins for Hib infections. The quinolone group of drugs are not recommended for routine use in children owing to concern about possible effects on growing cartilage. The development of an effective Hib vaccine had led to the virtual elimination of invasive Hib infections, including epiglottitis, in developed countries where the vaccine has been incorporated into the routine infant immunization schedule.¹⁰ Its use in India is hampered by its expense and the lack of definitive data on the epidemiology of Hib infections in the country.¹¹

In conclusion, an approach which gives priority to early, elective airway protection in controlled conditions in a multidisciplinary intensive care setting offers optimum management and results in a satisfactory outcome for patients with severe croup syndromes. In the average peripheral Indian hospital setting, where good ENT and anesthetic expertise for surgical airway intervention may be lacking, judicious and timely use of medical approaches to airway management may help to minimise morbidity and mortality. There is a need to devise and apply management protocols for UAO that is suitable for each situation based on available facilities.

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NINTH ENDOSCOPIC SINUS SURGERY COURSE

(Under the auspices of All India Rhinology Society)

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