CROUP : A PRIMER

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OPSOMMING

Kroep is die enkele mees gewone oorsaak van dood deur lugwegobstruksie as alle ouderdomme in aanmerking geneem word. Die pasiënt se algemene voorkoms is 'n uiters onvertroubare gids tot die erns van die obstruksie in kroep en spesifieke tekens moet gebruik word in die skatting. Hantering word bespreek. Dit word beklemtoon dat borsfisioterapie spesifiek **teenaangedui** word in kinders met kroep wat konserwatief hanteer word. Maar in kinders by wie 'n kunsmatige iugweg vir lewensdreigende lugwegobstruksie ingevoeg was, is gereelde intensiewe borsfisioterapie **noodsaaklik**.

SUMMARY

Croup is the single most common cause of death from airway obstruction, taking all ages into account. The patient's general appearance is an extremely unreliable guide to the severity of the obstruction in croup and specific signs must be used in the assessment. Management is discussed. It is emphasized that chest physiotherapy is specifically **contra-indicated** in conservatively managed children with croup. But in children who have had artificial airways inserted for life threatening airway obstruction regular intensive chest physiotherapy is **essential**.

Asthma and croup are both potential causes of life threatening airway obstruction. We hear a great deal about the one and little of the other. Yet more of those born in South Africa today will die of airway obstruction in croup than of asthma. The reason we adults have so little regard for the condition is that croup "only affects children". Once we have survived childhood we happily forget about the condition, unless of course it affects one of our own or we become involved in the care of a child with croup.

Croup has a particularly nasty reputation for doing the unexpected and many doctors fear having to deal with a case. It seems to behave capriciously, producing sudden collapse in children who do not seem to have severe airway obstruction. However, croup is not like this at all. It is very predictable if one knows what to look for. It is only when our attention is focussed on the wrong physical signs that the unexpected disasters occur. Nurses and physiotherapists play an indispensable role in the management of croup and they often are in a position to guide the medical staff. The purpose of this article is to provide nurses and physiotherapists with the information necessary for the rational management of children with croup.

THE NAME

Croup describes the clinical syndrome produced by acute obstructive infraglottic laryngitis, whatever the cause. It is also referred to as laryngo-tracheo-bronchitis (LTB) but the simpler term is now generally preferred. At one time all cases were thought to be due to diphtheria and in many European countries croup and diphtheria are still regarded as synonymous terms. They use pseudo-croup to describe croup associated with other agents.

PATHOPHYSIOLOGY

Airway obstruction in croup occurs from inflammatory swelling of the larynx immediately below the vocal cords, hence the name obstructive infra-glottitis. Both the larynx and trachea show the features of catarrhal inflammation in croup: shedding of epithelial cells, submucosal œdema, inflammatory cell infiltrate, dilated capillaries, and distended submucosal glands. However it is only the subglottic portion of the larynx which becomes sufficiently obstructed in croup to pose a threat to life. The reason for this peculiarity is that submucosal glands are profuse in the subglottis but relatively sparse in the trachea. It is the distension of these glands which is the major cause of the airway obstruction in croup.

The small anatomic size of the paediatric airway explains why young children may suffer life-threatening obstruction with laryngitis while adults seldom have more than a hoarse voice.

The degree of airway obstruction with croup varies typically with the breathing cycle. Air flow is accelerated as it is sucked thorough the narrowed subglottis. The intra-luminal pressure drops.* The subglottic walls are sucked together and vibrate - much as the reed of a wind instrument does - producing the typical harsh inspiratory nose we call stridor. Noise is not produced during expiration because the vocal cords adduct**, partially obstructing airflow downstream of the subglottis, increasing the intraluminal airway pressure and distending the airway. **Crying is associated with vigorous inspiratory efforts which increase intraluminal suction pressure and the degree of airway obstruction.**

* This is termed the Bernoulli effect after Daniel Bernoulli (1700-82), a Swiss mathematician. He found the sum of kinetic energy (flow) and pressure energy to be a constant in an ideal gas under conditions of steady flow. In other words, when the flow rate increases, the energy carried as kinetic energy in the gas increases and pressure energy (i.e. pressure) drops, it may become markedly subatmospheric. The Bernoulli effect is put to practical use in Venturi meters, airplane wings, carburetors, etc.

** The vocal cords have an important function during normal breathing. They open widely during inspiration to facilitate passage of air into the lung. Failure of abduction in bilateral vocal cord paralysis causes severe inspiratory obstruction. Partial closure during inspiration facilitates gas exchange by preventing the too rapid escape of air from the lungs.

CAUSE

Viral infections are the usual cause of croup. Para-influenza virus is the most frequently identified pathogen in *viral croup* but any upper respiratory tract viral infection may produce croup. We are cautious in our use of steroids in cases of croup in Cape Town because about 15 percent of our severe cases are due to herpes simplex laryngitis, the most frequent cause of croup following measles. *Post-intubation croup* following physical injury to the subglottis by the use of an excessively large endotracheal tube during anaesthesia is an important preventable iatrogenic cause of croup. *Bacterial croup* - also know as bacterial tracheitis - from staphylococcal, pneumococcal or H. influenzal infection is described but is uncommon. Systemic toxaemia, fever over 39°C, rapid progression of the illness, purulent secretions or an associated pneumonia should raise suspicion of it. Diphtheric croup is now rare but must be considered when croup occurs in an unimmunised child. *Spasmodic croup* is a form or recurrent croup precipitated by viral infections in older allergic (atopic) children. The name derives from the episodic nature of the condition. The attacks are characterised by fairly acute onset and rapid resolution. The pathology appears to be the same as in viral croup.

A discussion of other causes of laryngeal obstruction is beyond the scope of this paper: epiglottitis, anaphylaxis, laryngeal papillomata and laryngeal foreign bodies. They are generally fairly easy to distinguish from croup by history alone.

CLINICAL FEATURES

The typical case of *viral croup* is a previously well child below 2 years of age who develops inspiratory stridor and a barking cough a day or two after what seemed to be a common cold. In fact there is little else to consider in a child with this history. Croup is rare over the age of 10 years and children with *spasmodic croup* have generally outgrown it by the time they start school.

Assessment of Severity

The child's general appearance in croup may completely mislead one. The apathetic tachypnœic child with marked retractions and cyanosis is in obvious need or urgent attention. What is not intuitively obvious is that a child who appears to be undistressed can be at as great a risk of suffocation. Failure to appreciate this fact has given the disease a bad name. It is only by grading the severity of airway obstruction in croup according to the following table that serious errors can be avoided.

At first, the airway obstruction in croup is purely inspiratory and accompanied by the characteristic inspiratory stridor and barking cough. Expiratory obstruction occurs as well when the subglottic obstruction becomes more severe. Initially this is detectable only by finding prolonged expiration: "passive" expiratory obstruction. With increasing severity of obstruction expiration becomes forced, or "active", with visible or palpable abdominal muscle contraction. Sometimes an expiratory wheeze is heard which may be confused with asthma in children with grade III obstruction. A palpable weakening of the pulse during inspiration (pulsus paradoxus) is generally present in children with severe obstruction.

Blood gases are of virtually no value in the assessment of children with croup. Carbon dioxide tension reflects the patient's ability to compensate for the airway obstruction, and does not reflect the degree of obstruction *per se*.

CLINICAL SIGNS

	INSPIRATORY OBSTRCUTION	EXPIRATORY OBSTRUCTION	PALPABLE PULSUS PARADOXUS
SEVERITY			
Grade I	+		
Grade II	+	PASSIVE	
Grade III	+	ACTIVE	+
Grade IV	Marked retractions, apathy, cyanosis		

TABLE: Severity of Airway Obstruction in Croup

MANAGEMENT

The child is managed according to the clinical severity of the airway obstruction (Table). The majority of children with croup will require supportive conservative care only. However, about 10 percent will require an artificial airway.

Supportive Care : Grades I and II

Children with grade I or II obstruction are managed conservatively. Because of the adverse effects of crying in croup, every attempt is made to keep the child happy. A parent should remain with the child. He is fed as usual. Any procedure which may provoke crying, such as blood sampling, airway suctioning, and chest physiotherapy, is specifically contra-indicated. Sedation is used if the child cries inconsolably in spite of these measures.

Children with grade I obstruction can be nursed at home, depending on the course of their illness and access to transpiration. Those with grade II obstruction are best admitted for observation and for adrenaline inhalations* Adrenaline is given half-hourly until the obstruction improves to grade I, when it is discontinued to avoid any side-effects. These only occur when inhalations are given to children with mild obstruction who do not need them. A tachycardia in a patient with grade II or more severe obstruction is an indication for adrenaline, not against its use.

The majority of children with croup show some improvement following adrenaline. Precisely why is not clear. Its big disadvantage is it brief duration of action. Treatments must be repeated every 30 minutes or so. They cannot be hurried and are time consuming. Patience, skill and ingenuity are needed to avoid precipitating crying with the treatment as this will, of course, negate it effect.

Artificial Airways

Children with grade III or IV croup are admitted to an intensive care unit. Adrenaline with oxygen is administered

* One ml of Adrenaline 1/1000 (1 mg) is diluted with one of 0,9% saline and nebulized with oxygen 3-5 l/min. The dose is repeated as indicated.

continuously. An artificial airway is inserted as a matter of urgency when grade IV obstruction fails to show almost immediate improvement to grade III or better on adrenaline. Grade III obstruction which fails to improve to grade II within 2 hours or so is also treated with an artificial airway.

The choice between tracheostomy and endotracheal intubation is dependent on local conditions. **Primary tracheostomy is strongly recommended to units which do not have warmed humidification, skilled nursing and physiotherapy available.** Tracheostomy is also done for *bacterial tracheitis* with profuse purulent secretions, when extensive herpetic ulceration of the larynx is present, or when subglottic stenosis is present.

There are 2 major hazards faced by children with artificial airways *in situ:* tube dislodgement and obstruction.

Dislodgement occurs by insecure fixation of the tube. It is particularly important to ensure that tracheostomy tapes are securely tied. Stitching of the tracheostomy tube to the skin to the neck is barbaric and completely ineffective at preventing dislodgement - the skin is too mobile. Care should also be taken to avoid traction on the tube by humidifier connections and during procedures. A mask is therefore preferred over a tracheostomy. The hands should be immobilized initially (we tie them to the cot with stockinette) and occasional sedation may be employed. However, before using sedation one must be sure that there is not a specific reason for the child being unhappy: tube blockage, hungry, wet, etc. The need for regular sedation usually indicates that one of these problems is present.

The only way to avoid **tube obstruction** is through the use of *warmed humidification*, through *regular aspiration* of sputum and through *regular physiotherapy* to mobilize and prevent accumulation of secretions. Endotracheal tubes are long and narrow and are more dependent on meticulous care to maintain their patency than are the shorter tracheostomy tubes.

Sticky secretions always imply inadequate humidification. Saline or a mixture of mesna (MISTABRON)* *in water* may be used to clear inspissated secretions. The need for them implies an urgent need for better humidification. They are no substitute for adequate humidification and should not be instilled down the airway as a routine measure.

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* Mesna is very hypertonic and irritant. It must be diluted with WATER for injection prior to instillation down the airway: 1 part mesna to 4 of water. Saline will not reduce the osmolality of mesna.

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Contributions are invited on any topic related to physiotherapy or rehabilitation. They can be full-length articles or short reports. A full-length article may be a report of research, a description of an approach, a literature review or a presentation of a theory. A short report may be a case or clinical report, a treatment technique or suggestion.

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Books:

1. Maitland G D. *Vertebral Manipulation*. 4th ed. London: Butterworths, 1977: 24.
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