OBSTRUCTED AIRWAY

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Introduction

The small size of the larynx and trachea makes airway obstruction particularly dangerous in infants and children. Hypoxia due to impairment of airway is a frequent cause of morbidity and mortality in paediatric age.

Airway obstruction is due to alteration of the upper respiratory tract (e.g. nasal cavity, nasopharynx, larynx) and lower respiratory tract (e.g. trachea, bronchi and bronchioles, alveoli) and can derive from congenital malformations, infectious diseases, trauma and oedema.

Airway obstruction can appear after a simple inflammation of upper airways and may progressively deteriorate until emergency stage.

Airway obstruction, due to the severity of complications and possible evolution of hypoxia into cardiac arrest, must be treated immediately. The treatment is devoted to maintaining patency of airways and ensuring adequate ventilation. Patency of airways and adequate ventilation can frequently be obtained only with endotracheal intubation.

Tracheal intubation

Tracheal intubation is the optimum method to control patency of airways and ventilate the lungs adequately. Inability to perform intubation on infants and children is a frequent problem, and leads to a large number of complications. Severe brain damage and death can follow failed intubation and consequent hypoxia**.** Tracheal intubation is not easy to perform in paediatric age and requires specific training and notable skill. It can be performed under direct laryngoscopy or using special apparatus such as a fibreoptic laryngoscope. Emergency intubation has to be managed by expert and welltrained staff.

Intubation can be performed: 1. awake and without drugs in newborns, in comatose patients and in emergency; 2. during sedation, local or general anaesthesia, in spontaneous breathing, in cases of congenital malformations, difficult airway and severe respiratory failure; 3. during general anaesthesia and muscular blockade in cases of patent airway and easy assisted ventilation.

Difficult intubation due to airway obstruction

Difficult intubation can be **suspected or unexpected**. In the case of suspected difficult intubation a well-planned and flexible approach must to be taken. Idoneous equipment has to be used and a welltrained specialist should be present. Reduced complications and failures in intubation have been

reported in well-programmed situations. Accurate anamnesis and qualified clinical examination can reduce the difficulty in performing intubation.

Difficult intubation can be divided in two major groups:
1. in the first group direct visualization of the glottis is difficult or impossible because of facial, oral congenital or acquired malformations;
2. in the second group visualization of larynx is easy under direct laryngoscopy but a supraglottic, glottic or subglottic stenotic lesion prevents passage of the usual size tube.

The first group is represented by congenital malformations frequently characterized by micrognatia (due to mandibular hypoplasia) including craniofacial dysmorphologies (e.g. Pierre-Robin syndrome), mandibulo-facial dysostosis (Treacher-Collins syndrome), mandibulo-auriculo-oculo-vertebral dysplasia (Goldenhar syndrome), oculo-mandibulo dyscephaly (Hallerman-Streiff syndrome), Mobius and Cornelia de Lange syndromes and Freeman Sheldom syndrome.

Laryngo-tracheomalacia and vocal chord paresis, even though they present narrowed airways, allow the passage of an endotracheal tube of usual diameter. The laryngo-tracheo-esophageal cleft allows an easy passage of the tube through the glottis but the placement of the tube in trachea is difficult according to the anatomical malformation.

The second group includes congenital malformation, acquired lesions such as laryngotracheitis, epiglottitis, croup, subglottic stenosis following incorrect tracheal intubation, etc., the presence of foreign bodies, internal and external trauma**.**

1. Techniques suggested in difficult intubation due to non visualization of glottis and vocal chords.

Several methods have been proposed but only one can be effective in 90% of cases using fibreoptic laryngoscope. The availability of increasingly smaller caliber fibreoptic laryngoscopes has led to their widespread use in paediatrics, facilitating most notably difficult intubation and diagnostic bronchoscopy [19]. Fibreoptic bronchoscopes are available in various sizes, the smallest being 1.8 mm, which can fit through a 2.5 mm ID endotracheal tube. The apparatus allows continuous oxygen supplementation directly into the airways, as well as bronchosuctioning, except with a 3.5 mm diameter or smaller fibreoptic laryngoscope.

Lighted stylet (Lightwand) Bullard Laryngoscope and several laryngoscope blades have been proposed for difficult intubation in specific circumstances. Belscope, an angulated laryngoscope [22] and rigid tubular laryngoscope, can be recommended to visualize the glottis in the presence of severe oedema of the additus laringeus or a large and occluding tongue. The equipment is used almost exclusively in adults and use in newborns and infants has yet to be demonstrated. The equipment may possibly be more useful in children over 10 years.

2. Techniques suggested in difficult intubation due to laryngeal and tracheal stenosis.

Laryngeal and tracheal stenosis are the most frequent situations in which the passage of gases into the trachea and ventilation are difficult. In general the patient is able to maintain a minimal gas exchange even though it may be accompanied by significant muscle effort. The visualization of vocal chords is possible but the passage of the tube into the trachea is difficult due to edema, inflammation, congenital or acquired malformations or presence of foreign body in additus laryngeus, subglottic and cricothyroid region.

In cases of visible foreign body, its removal using laryngoscope and forceps or using a fibreoptic laryngoscope is useful for rapid restoration of patency of the glottis.

In cases of oedema, inflammation or patent anomalies it is necessary to improve the passage of air

through the vocal chords in order to guarantee a minimum gas exchange. Endotracheal intubation is required for the aforementioned.

Intubation

These patients must be manipulated with delicacy in order to maintain a minimum passage of air in the trachea and to avoid laryngospasm. High oxygen concentration must be administered in order to guarantee sufficient PaO2 during spontaneous breathing and until access to trachea has been ensured and ventilation is controlled. Muscle relaxants are contraindicated in cases of suspicion of failed intubation or when manual ventilation by mask can be difficult.

Tracheal intubation can be performed with children under sedation or during general anaesthesia. Halogenate anaesthetics are useful as they allow sedation of the patient, maintenance of spontaneous breathing and bronchodilatory effect.

All material necessary for intubation must be previously checked and different sizes of tubes, starting from 2 mm ID, must be available.

Technique

Having visualized laryngeal additus by laryngoscope, a semi-rigid tracheal tube of suitable diameter is advanced into the larynx through the mouth. Oral intubation is preferred as it is easier to perform in emergency.

Once a safe airway and sufficient ventilation have been assured, the patient can be paralysed. A short-acting curare is preferred in order to return rapidly to spontaneous breathing.

Well-lubricated progressive sizes of semi-rigid tubes are positioned in the trachea, one after the other, pressing on stenotic area until a possible maximal size is introduced in conformity with the normal anatomy and stenosis.

The patient is subsequently intubated with a common soft tube (PVC or silicon rubber) using 1/2 calibre less than the maximum reached during dilation. In this case nasal intubation is preferred as it allows the tube to be fixed stably, so avoiding dislocation and selective intubation. Nursing is easier and related complications are reduced. Oral intubation is not advised because of the frequent dislodgement of the positioned tube due to tongue movements and difficult fixation of the tube. Atelectasis can follow in cases of selective bronchial intubation.

Artificial ventilation must be maintained until any possible lung pathology is resolved and the patient has acquired spontaneous breathing. Continuous Positive Airway Pressure (CPAP) can be used if the child presents sufficient spontaneous breathing. In order to reduce the resistance created by a small diameter tube, pressure support (5-10 cm of H2O) can be applied to overcome fatigue. Good results have been obtained using Volume Support Ventilation. This method allows a preset tidal volume to be maintained using the minimal inspiratory pressure. In cases of apnea, the ventilator switches automatically to Pressure Regulated Volume Control - PRVC- ventilation.

A progressive PEEP level from 10 to 15 cm of H2O must be applied in order to create an "air pillow" around the tube and favour progressive dilation of stenotic area. Improved stenosis is confirmed by increasing tube leakage. Humidified and warmed gases are indispensable during the treatment in order to maintain secretions fluid and easily drainable and to favour resolution of inflammation and oedema. When the leakage is evident, it is possible to reduce PEEP progressively in order to stabilize the beneficial effects obtained and proceed to extubation.

Non severe oedema, e.g. post intubation oedema, and inflammatory stenosis (e.g. acute laryngitis and epiglottitis) resolve spontaneously in 4 to 5 days. In cases of difficult extubation and if leakage does not appear, the dilation manoeuvre can be repeated after 3-4 days for two or three times. If difficult extubation persists after 1 month, other treatments must be considered to resolve the pathology.

Tracheotomy is not considered an emergency procedure today. It is limited to tracheal stenosis and iatrogenic injury to the upper airway, complete impossibility of intubation, in laryngeal disruption and complex craniofacial injury, in basilar skull fractures with cerebrospinal fluid leak and/or nasal fractures or deformity which contraindicate a nasotracheal tube, in arch bars and jaw wiring, and in chronic patients needing some ventilatory support.

Prolonged tracheal intubation has replaced tracheostomy, particularly since the introduction of soft, long-lasting, atoxic endotracheal tubes which are well tolerated and suitable for long term use.

In newborns, infants and young children, tracheostomy is to be avoided because of the damage deriving (severe reduction of tracheal diameter) due to the smaller size of the child’s trachea compared to that of the adult. Severe stenosis and difficult decannulation are the norm after tracheostomy in paediatric age.

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