Acute upper airway obstruction (UAO) is common in preschoolers in urban settings. This paper summarizes the role of each health care professional involved in the management of UAO, and dwells particularly on the anesthetist's contribution to the team.

Infectious diseases, namely laryngotracheobronchitis (croup) and acute supraglottitis, are the most frequently encountered life-threatening conditions in the preschool age group. Proper management requires teamwork by the pediatrician, emergency room physician, otolaryngologist and anesthetist.

It is first important to classify various types of upper airway obstruction (UAO) by etiology.

Inflammation. The most common cause of respiratory obstruction in children is laryngotracheobronchitis, commonly called croup. This is an infectious disease of preschool children that has a viral etiology, most frequently parainfluenza types 1, 2 and 3. Its onset is generally gradual, with an associated URI-like syndrome. Progressive inspiratory stridor with hoarseness are consistent symptoms caused by the glottic and subglottic swelling. A barking cough is characteristic. The obstruction is usually mild but may become progressive, leading to severe dyspnea, particularly in children under the age of two. Conversely, children with moderate obstruction may become fatigued if the disease continues past a few days.

Acute epiglottitis is a fulminant disease caused by the Haemophilus influenza type B bacteria. The child is usually between one and seven years of age, but exceptions occur on either end of this scale. The progression of the disease is rapid: the child may become completely obstructed in two hours after previously being perfectly well.

A look at the affected anatomy explains why the disease may be so rapidly fatal. Edema of the epiglottis and aryepiglottic folds caused by inflammation occludes the airway. The glottis and subglottis are normal. The child is toxic; obstruction is severe. The voice is muffled—the so-called "hot potato" voice. The child's throat is sore and he drools because he is unable to swallow. Hypoxia and fear cause anxiety in the child. Characteristically, the child sits upright with his head forward.

Retropharyngeal abscess may occlude the airway subglottically. In the very young, this formation may be caused by any infection in the head and neck which has lymphatic drainage to the retropharyngeal area. After the preschool years, retropharyngeal abscess is usually related to foreign bodies or instrumentation.

Acute adenotonsillitis, particularly in association with infectious mononucleosis, may result in acute UAO in any age group. Most such cases are
managed with nasopharyngeal intubation and administration of antibiotics. Steroids are helpful when infectious mononucleosis is present. Occasionally the obstruction must be surgically removed as an emergency procedure.

For the sake of completeness, diphtheria, virtually eliminated by immunization except in some parts of the world, should be mentioned. The characteristic membrane of the disease causes obstruction by laryngeal occlusion. If a tracheotomy is performed and the patient survives, chronic obstruction with glottic stenosis may occur.

**Traumatic.** Trauma to the larynx may be external or internal. External trauma is classically caused by a dashboard injury or a blow to the front of the neck. The injury may cause swelling in the airway or actual cartilaginous fracture.

Today, internal trauma is most often a result of instrumentation. Subglottic swelling may result from prolonged intubation or inadvertent cuff inflation in this area. Arytenoid dislocation can occur in association with traumatic intubation. Arytenoid dislocation causes odynophagia and hoarseness with obstruction. Prolonged intubation usually causes progressive obstruction similar to croup over the two weeks following extubation.

Ingestion of caustic chemicals may cause obstruction at the glottic or supraglottic levels. Diagnosis often can be made from looking at the patient's history. Inhalation of noxious fumes, such as ammonia fumes, can cause similar problems.

Foreign bodies in the airway or surrounding structures are common in children. The foreign bodies may lodge anywhere from the nose to the bronchus and give signs and symptoms in relation to their location. Foreign bodies in the esophagus at the ericopharyngeus may compress the trachea from behind, causing partial obstruction.

**Congenital.** The congenital causes of acute upper airway obstruction are legion. In the newborn, nasal obstruction due to edema or choanal stenosis may cause respiratory embarrassment. Macroglossia or micrognathia likewise will present an emergency situation. All of these problems are treated temporarily by establishing an oropharyngeal airway.

Supraglottic congenital cysts that appear may enlarge in the first few weeks of life. Children with supraglottic congenital cysts have a muffled cry and severe retractions. Management is by intubation and definitive surgery.

Children may be born with webs in the glottis between the vocal cords. Complete webs are, of course, incompatible with life unless ruptured in the delivery suite. Incomplete webs require tracheotomy and definitive surgery. The most common glottic obstruction is vocal cord paralysis, in which both cords are in the parame-dian position. This condition may be related to a central nervous system disease such as hydrocephalus or meningomyelocele, or may be associated with cardiovascular anomalies. The majority of children born with bilateral vocal cord paralysis have no known associated lesion and are termed idiopathic. Management is by tracheotomy over an endotracheal tube and ongoing observation.

Congenital subglottic stenosis is fairly common. Frequent episodes of croup point to such a diagnosis. In the very young, treatment consists of tracheotomy. Time generally relieves the obstruction.

Vascular rings around the trachea cause obstruction in the trachea. The characteristic expiratory stridor is evident after the child doubles his birthweight.

**Metabolic.** Hypothyroidism with myxedema can cause airway obstruction, but this is a rare occurrence. Edema of the glottis is noted on examination.

Hereditary angioedema causes laryngeal edema after minor trauma. It is related to an enzyme deficiency in the complement system and presents as an airway emergency. Medication is now available to prevent attacks.

**Allergic.** Allergic disease is seldom the cause of upper airway obstruction. Allergic or spasmodic croup is common but usually mild and transient. This type of croup is often relieved by vagal discharge. This premise is the origin of the old adage that a child with croup should be made to vomit.

**Neoplasms.** In children, malignant neoplasms of the larynx are rare. However, juvenile papillomatosis of the larynx is increasingly common and may cause profound obstruction of the airway. The growths are usually viral and look like cauliflower warts. Laryngeal anatomy is extremely distorted by hoarseness, which is a universal symptom. Removal of the growths with lasers or microsurgery is a temporary treatment; they usually reoccur within six months. Most spontaneously regress by age twenty.

**Team management**

It is incumbent upon the primary care physician to provide the initial management for the obstructed child and to arrange for expeditious ongoing management. The basis for this organization must lie within the emergency room in the form of a protocol. The protocol should address admission procedures and responsibilities of emer-
gency room nurses and residents. It should specifically state routines, communication channels and disposition of the child. The actual protocol will not be specified here, but it is necessary to emphasize a few highlights.

The child in respiratory distress is left in the care of his mother or one nurse and his vital signs are monitored closely. The history is taken from the relative by a single physician, who then stays with the child. Ear-nose-and-throat, anesthesia, the operating room, and the intensive care unit are notified of the case and informed of the child's age and severity of symptoms.

After obtaining the history, the physician carries out a limited examination, mostly by inspection. The child is allowed to assume a position of maximal comfort and is given mist and oxygen. If circumoral cyanosis occurs, urgent action must be taken as soon as the required personnel are assembled. In its absence monitoring of the pulse rate and respiratory rate give the best indication of systemic oxygenation (see Table 1).

Unnecessary procedures, which may frighten an already anoxic and anxious child, are omitted. These unnecessary procedures include establishing an intravenous line, drawing blood gases or examining the throat. As soon as possible, the child is moved to either the intensive care unit or operating room, according to his condition and the availability of personnel.

If the child's history and a cursory examination do not yield a specific diagnosis, radiographs of the neck may be warranted. The x-ray is brought to the child and performed as a portable in the emergency room or intensive care unit. By the utilization of "portable" techniques and by adequate preparation, these films may be taken safely and quickly. A lateral neck film can be used to rapidly differentiate croup from epiglottitis. This is important in that the child with croup warrants administration of racemic epinephrine as a trial therapy before being committed to an operative procedure which will inevitably result in a tracheotomy.

**Operative intervention**

When it becomes apparent that an artificial airway must be established, the child is moved to the operating room where management is undertaken by the anesthetist and otolaryngologist. The duties of each will be presented here separately, but neither can safely work in isolation.

Acute epiglottitis is commonly managed with nasotracheal intubation for 48 hours or more, with subsequent extubation in the operating room under direct vision. This management plan requires a well-trained intensive care unit staff and house staff that is prepared to deal with accidental extubation. Should the facilities or personnel not be available, performance of a tracheotomy is a perfectly acceptable method of management. Croup is usually handled by tracheotomy when medical means of treatment have failed, although some hospitals are attempting long-term nasotracheal intubation.

Many methods of establishing the initial airway are practiced in various areas of the world. Some anesthetists feel the child should be intubated awake to maintain reflexes. In some hospitals, a bronchoscope is always the initial instrument for airway establishment. Most large pediatric referral centers are now using inhalation anesthesia for this procedure. In skilled hands this probably does not significantly increase the risk to the child and probably decreases the incidence of traumatic intubation and residual psychologic consequences.

Whatever the technique, the otolaryngologist must have set up a bronchoscope of appropriate size and length. If the anesthesia staff is to perform the intubation, this back-up equipment should be in position prior to induction of anesthesia. After intubation a careful inspection of the larynx is carried out.

**Anesthetic technique**

**Preparation.** Preparation commences as soon as word of the child's age and tentative diagnosis is received from the emergency room. The size of the airway is calculated and nasotracheal tubes of that size and the next two smaller sizes are readied along with McGill™ forceps and corresponding sized endotracheal tubes. Masks, monitors, stylettes, bite-blocks, suctions and appropriate size laryngoscopes are all set out. An intravenous infusion is readied; atropine and succinylcholine for intravenous use are drawn up separately. The table is positioned with the head up to permit the child to sit.

**Positioning.** The child with severe obstruction is unable to swallow secretions; these pool in the pyriform fossae. Placing such a child in the recumbent position is liable to induce aspiration with laryngospasm. The child is moved from his bed in a sitting position to a similar position on the operating table.

**Monitoring.** A precordial stethoscope and blood pressure cuff along with electrocardiographic leads are placed on the child. The blood pressure cuff is omitted if it upsets the child.
Preoxygenation. While the child is positioned and the equipment for monitoring placed, the child is preoxygenated by holding the mask close to the face. Very few children in respiratory distress will permit a mask to be held tightly to the face without becoming more agitated.

Induction. This is carried out with the use of an anesthetic gas with a low maximum allowable concentration (MAC), such as halothane. Most anesthetists will use nitrous oxide to speed induction if the child appears to be exchanging well. Some will insist on an oxygen-halothane induction for even a mild degree of obstruction.

Intravenous. Once the anesthetic has been deepened sufficiently to prevent movement, an intravenous catheter is passed and atropine in blocking doses is given. The intravenous line is then secured with tape and fluids given to maintain the line.

Assistance. Gradually the anesthetic is deepened and the child’s ventilation is assisted with light positive pressure. If it is not possible to assist ventilation through the obstruction, muscle relaxants are not given. Intubation must be accomplished without relaxation in such cases.

Intubation. When the patient is ready, the larynx is exposed with the tip of the laryngoscope blade in the valecula. Accumulation of secretions within the laryngeal vestibule and pyriform fossae should be anticipated and suctioned. The condition of the supraglottis is then determined and a management decision made. For epiglottitis cases, eventual management will be by nasotracheal intubation. If it appears that intubation will be difficult, it is probably wise to perform endotracheal intubation first, because within five minutes a sufficient amount of edema of the epiglottis will have been squeezed out to permit easy nasotracheal intubation under direct vision. If the tube meets resistance at the cords or below, a smaller nasotracheal tube is used.

If an airway cannot be seen at all, a small amount of pressure to the abdomen will expel air through the inflamed supraglottis. The anesthetist should be aware that this maneuver could lead to the expulsion of vomitus as well and create the complication of aspiration. If an airway still cannot be seen, the patient is again ventilated by mask and positive pressure. Once adequate oxygenation is attained, intubation with a bronchoscope is carried out.

Positive pressure. After relief of the obstruction the patient should be kept on positive pressure. This is felt to decrease the incidence of pulmonary edema caused by the sudden relief of the high intrathoracic pressure in combination with a sudden increase in venous return.

Securing the airway. The tube is now secured with tape after its position is checked by auscultation. Tincture of benzoin is applied to the skin to ensure adhesion of the tape. A nasogastric tube is passed to combat abdominal distention from the swallowing of air, and intravenous sedation is given prior to termination of the procedure. Morphine sulfate 0.2 mg/kg is administered. This may be supplemented with diazepam 0.2 mg/kg. These doses are adjusted in the intensive care unit according to the patient’s response.

Cultures. Cultures of the hypopharynx and blood are drawn before the patient leaves for the intensive care unit. Anaerobic and aerobic specimens are sent to the laboratory.

Complications

Cardiopulmonary arrest. If the obstruction becomes so severe that the patient arrests, appropriate measures include normal resuscitative efforts using positive pressure ventilation with bag and mask. Probably one attempt at intubation by the most experienced person present would be warranted. Studies have shown that ventilation can be maintained by positive pressure with 100% oxygen. Emergency tracheotomy or the insertion of needles into the trachea should be a last resort.

Pulmonary edema. If pulmonary edema does occur, management is with CPAP, PEEP, diuretics, and fluid restriction alone or in combination. Generally, it is transient in nature. Therapy is monitored with blood gases as required.

Pneumothorax and pneumomediastinum. These may occur after traumatic intubation, tracheotomy, or positive pressure when the tube has a complete seal. All patients should have chest radiographs upon their return to the intensive care unit to check tube position. If a pneumothorax is present it is managed with closed chest drainage. Pneumomediastinum seldom requires treatment.

Conclusion

In conclusion, acute upper airway obstruction in children requires teamwork by specialists in many areas of health care. Meticulous management prevents increased morbidity and mortality. With prolonged intubation and total respiratory care becoming the primary means of treatment, the nurse anesthetist’s role in the management of UAO becomes even more important.

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