

Chapter 16: General Considerations in Pediatric Otolaryngology

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Pediatric otolaryngology is a specialty within otolaryngology - head and neck surgery that is helping to bridge the gap between a surgical discipline and pediatric medicine. This trend began with pediatric surgery, continued with pediatric anesthesiology and is continuing with ophthalmology, urology, and other surgical subspecialties.

Almost every surgeon practices pediatric otolaryngology at times: a cancer surgeon who treats childhood lymphomas, the otologist who corrects aural atresia, and the facial plastic surgeon who deals with children's nasal fractures are all involved in the care and treatment of pediatric head and neck disorders. An estimated 25% to 50% of a general otolaryngologist's practice may be related to pediatric problems. For this reason the subspecialty of pediatric otolaryngology is becoming increasingly important in training programs. Learning about the special problems facing children, the approach to treatment, and special considerations related to diagnosis and surgical management is a vital part of any otolaryngology residency.

One difference between pediatrics and adult medicine is that although the patient is being treated, the parents also must be included in the initial evaluation. The parents as well as the child must have confidence in the surgeon, must understand the procedures being performed, and in many cases, must supply the history related to the illness. Complicating this situation is the fact that explanations, questions, and rapport are directed to two very different levels of maturity.

Physiologic differences between infants, children, and adults have occupied major research efforts and complete textbooks. The following introductory comments are meant to point out the differences between neonates, infants, children, and adults and should be used as a starting point for further investigation.

Respiratory System

Control of ventilation

Observations of neonatal control of ventilation are difficult to interpret. The intervention necessary to obtain measurements, such as the placing of a mask on the face or a tube into the larynx, may induce a change in the ventilation itself. In addition, the use of measurements of ventilation to assess respiratory drive is based on the assumption that the respiratory muscles are performing optimally to convert this drive into work - and that may not be the case in the neonate or infant.

The newborn's muscles are subject to fatigue, a tendency that is determined by the types of muscle fibers present. In preterm infants, less than 10% of the fibers in the diaphragm are type I (slow twitch, highly oxidative, fatigue resistant). In term infants, 30% of these fibers are type I, and the percentage increases to 55% (approximately the adult level) over the first year of life. The preterm infant is thus very prone to ventilatory muscle fatigue, a predisposition that progressively disappears with advancing maturity. Changes that occur

during changing sleep states also affect ventilation. The preterm infant spends 50% to 60% of the time in rapid eye movement (REM) sleep, during which intercostal muscle activity is inhibited, and paradoxical movement of the soft chest wall occurs. This lack of intercostal activity is compensated for by an increase in diaphragmatic activity, much of which is wasted when the ribs move paradoxically and which may lead to diaphragmatic fatigue.

Control of ventilation that involves biochemical and reflex mechanisms is at least partially developed in the healthy, full-term neonate. The ventilatory response to increased concentrations of carbon dioxide is proportionally similar to that of adults; however, ventilation relative to body mass is greater for any given partial carbon dioxide pressure, reflecting a higher metabolic rate. The response of the preterm infant to a specific inspired carbon dioxide level is less than in adults. The newborn is also sensitive to changes in arterial oxygen tension. Administration of 100% oxygen decreases ventilation, indicating the existence of chemoreceptor activity.

Many factors modify the ventilatory response of the newborn to hypoxia, including gestational and postnatal age, body temperature, and sleep state. Preterm and full-term infants less than 1 week old who are awake and normothermic usually demonstrate a biphasic response: ventilatory depression preceded by a brief period of hyperpnea. Hypothermic infants respond to hypoxia with ventilatory depression without initial hyperpnea. This depression of ventilation is thought to be caused by the central effects of hypoxia on the respiratory center. The peripheral chemoreceptors that are demonstrated to be active in newborns are presumably unable to maintain a significant influence of this response. Infants may be even less responsive to hypoxia during REM sleep. During non-REM sleep, however, increased ventilation is sustained. The arousal response to hypoxia during sleep is not seen in newborns, but normally develops over the first few weeks of life. Infants over 1 week old demonstrate hyperpnea in response to hypoxia, probably because of the maturing of chemoreceptor function. Hypoxia that occurs during sleep usually results in awakening. During hypoxia the ventilatory response to carbon dioxide is depressed in the newborn, in contrast to that in infants and adults.

Reflexes arising from the lung and chest wall are probably more important in maintaining ventilation in the newborn, primarily determining the respiratory tidal volume.

Periodic breathing, which consists of rapid ventilation alternating with periods of apnea, occurs in many preterm and some term infants and is thought to result from incoordination of feedback loops controlling ventilation. During episodes of periodic breathing the arterial PCO_2 level is above normal, but the heart rate does not change significantly. Periodic breathing seems to have no serious physiologic consequences and usually ceases by 6 years of age. Some preterm infants demonstrate far more serious and indeed life-threatening episodes of apnea. These commonly exceed 20 seconds and are accompanied by bradycardia. Apneic episodes may represent an example of the failure of the response to hypoxia. Because many apneic episodes occur during REM sleep, ventilatory muscle fatigue may possibly be an etiologic factor as well as an impaired chemoreceptor response to hypothermia. Usually stimulation of the infant easily terminates apneic episodes. The incidence of apneic episodes is decreased by therapy with aminophylline, which gives central stimulation, or by institution of continuous positive airway pressure, which causes increased reflex activity of lung and chest wall reflexes.

Lung volumes

In the term infant, total lung capacity is approximately 160 mL, and the functional residual capacity is about half this volume. The tidal volume is approximately 16 mL, and the dead space volume is about 5 mL. In proportion to body size, all these volumes are similar to adult values; however, any increase in dead space is much more significant when related to the small volumes in the infant.

In contrast to the static lung volumes, alveolar ventilation is proportionally much larger in the newborn (100-150 mL/kg of body weight) than in the adult (60 mL/kg). This high alveolar ventilation in the infant results in a much higher alveolar-to-functional residual capacity ratio of 5:1, compared with 1.5:1 in the adult. Consequently the functional residual capacity is a much less effective buffer in the infant, so that changes in the concentration of inspired gases are much more rapidly reflected in alveolar and arterial levels.

The total surface area of the air-tissue interface of the alveoli is small in the infant (2.8 m²). When this area is related to the metabolic rate for oxygen, the infant, dependent on a smaller air tissue interface-to-oxygen metabolic ration than the adult, has a reduced reserve capability for gas exchange. This difference may have significance if congenital defects interfere with lung growth, or if the lungs become damaged. The remaining healthy lung tissue may be inadequate to sustain life.

Respiratory rate

In the newborn a respiratory rate of approximately 37 breaths/minute has been calculated to be the most efficient; this is close to the rate observed in the healthy newborn. The term infant is similar to the adult, requiring approximately 1% of his metabolic energy to maintain ventilation; the oxygen cost of breathing is 0.5 mL/0.5 L of ventilation. The preterm infant has a higher oxygen cost of breathing (0.9 mL/0.5 L), which is greatly increased if the lungs are diseased.

Ventilation-perfusion relationships

Ventilation and perfusion are imperfectly matched in the neonatal lung. The normal arterial oxygen tension in a newborn infant breathing room air is about 50 mm Hg. The tension increases to 70 mm Hg by 24 hours of age. The high alveolar-arterial oxygen difference in infants is also caused by persisting anatomic shunts in the relatively high closing volume (Table 16-1).

Cardiovascular System

Newborn heart and cardiac output

In healthy neonates the right ventricle exceeds the left wall in thickness; this preponderance is evident in the electrocardiogram (ECG), which shows an axis of up to + 180 degrees during the first week of life. After birth the left ventricle enlarges disproportionately. At approximately 6 months of age, the adult-ratio ventricular size is established. During the immediate newborn period the heart rate is between 100 and 170 beats/minute, and the

rhythm is regular. As the child grows, the heart rate gradually decreases (Table 16-2).

Sinus arrhythmia is common in children. All other irregular rhythms should be considered abnormal.

Systolic blood pressure is approximately 60 mm Hg in the term newborn, and the diastolic pressure is 35 mm Hg. These pressures vary considerably: they may be 10 to 15 mm Hg higher if clamping of the cord is delayed or the cord is stripped. In either case they fall to normal limits within 4 hours. Preterm infants have lower arterial pressures, as low as 46/25 in the 750-g baby.

The myocardium of the newborn contains less contractile tissue and more connective tissue than exists in the adult heart. Consequently the neonate's ventricles are less compliant when relaxed and generate less tension during contraction. Because of the low compliance of the relaxed ventricle tends to limit the size of the stroke volume, the cardiac output of the newborn is rate dependent; bradycardia is invariably accompanied by reduced cardiac output. The autonomic innervation of the heart is incomplete in the newborn, with a relative lack of sympathetic elements. This may further compromise the ability of the less contractile neonatal myocardium to respond to stress.

Blood volume

Blood volume varies considerably during the immediate postnatal period and depends on the amount of blood drained from the placenta before the cord is clamped. Delay in clamping or stripping the cord, as mentioned before, may increase the blood volume by over 20%, resulting in transient respiratory distress. Conversely, fetal hypoxia during labor causes vasoconstriction and a shift of the blood to the placental circulation. Thus, asphyxiated neonates may be hypovolemic.

The response to hypovolemia and restoration of the blood volume is of great importance to the surgeon because significant blood loss often accompanies surgery in the newborn. Withdrawal of blood during exchange transfusion has been demonstrated to cause a progressive parallel decline in systolic blood pressure and cardiac output. Reinfusion of an equal volume of blood restores these parameters to their original values. Changes in arterial blood pressure are thus proportional to the degree of hypovolemia. A newborn's capacity to adapt the intravascular volume to the available blood volume is very limited, perhaps as a result of less efficient control of capacitance vessels. The baroreflexes of the infant, especially the preterm infant, are not fully active, and this further compromises the response to hypovolemia. In summary, the infant's systolic arterial blood pressure is closely related to his or her circulating blood volume. The blood pressure is therefore an excellent guide to the adequacy of blood replacement or fluid replacement during anesthesia, a fact that is amply confirmed by extensive clinical experience.

Response to hypoxia

Because of a high metabolic rate for oxygen, hypoxemia can develop rapidly in the neonate, in whom the first observed response is usually bradycardia. During surgery the anesthesiologist should treat any episode of unexplained bradycardia by immediately

ventilating the patient with 100% oxygen. During hypoxemia, pulmonary vasoconstriction occurs, and the pulmonary artery pressure increases more than in adults. Changes in cardiac output and systemic vascular resistance in infants also differ from those in older children and adults. During hypoxemia the principal response in adults is systemic vasodilatation, which, together with an increased cardiac output, helps to maintain oxygen transport to the tissues. The fetus and some neonates respond to hypoxemia with systemic vasoconstriction. During fetal life, this vasoconstriction directs more blood to the placenta. After birth, however, this response may reduce cardiac output, thereby further limiting oxygen transport and forcing the heart to work harder. In the infant, early and pronounced bradycardia (in response to hypoxia) may be caused by myocardial hypoxia and acidosis.

In summary, neonates exposed to hypoxemia suffer pulmonary and systemic vasoconstriction, bradycardia, and a decrease in cardiac output. Rapid intervention is necessary to prevent this state from proceeding to cardiac arrest.

Blood volume and oxygen transport

Neonatal blood volume is approximately 80 mL/kg at term and about 20% higher in the preterm infant. The hematocrit is approximately 60%, and the hemoglobin content is 18 to 19 g/100 mL. The values for blood volume, hematocrit, and hemoglobin content vary from infant to infant, depending on when the umbilical cord is clamped. Little change in these values occurs for the first week of life, after which the hemoglobin level starts to fall. This change occurs more rapidly in the preterm infant.

Approximately 70% to 90% of the hemoglobin present at term birth is of the fetal type. The affinity of fetal hemoglobin for oxygen is greater than that of the adult hemoglobin. Thus fetal hemoglobin combines with more oxygen but releases it less readily in the tissues than does adult hemoglobin. Adequate oxygen transport to the tissues of the newborn infant therefore demands a higher hemoglobin concentration. Less than 12 g/100 mL constitutes anemia, and higher levels are very desirable in hypoxic states. Correction of anemia by blood transfusion is indicated if the infant requires oxygen therapy or is experiencing apneic episodes.

During the first weeks of life the hemoglobin and hematocrit levels decline steadily as a result of early suppression of erythropoiesis with improved tissue oxygenation and progressive increase in blood volume. This physiologic anemia in infancy reaches a low point at 2 to 3 months of age, with a hemoglobin level of 9 to 11 g/100 mL. At this time the fetal hemoglobin content has been largely replaced by adult hemoglobin, and, as a result, oxygen delivery at the tissues is improved. Provided that nutrition is adequate, the hemoglobin level then gradually increases over several weeks to a level of 12 to 13 g/100 mL, which is maintained during early childhood.

Fluids and Fluid Management

Operative and postoperative fluid management in children should follow the same principles used in adults: replacement of maintenance requirements and correction of any existing deficits. Physiologic differences between neonates, infants, older children, and adults make fluid administration more critical. Essentially, children, because of their small

intravascular volume (70-80 mL/kg), can become dehydrate *or* excessively hydrated very easily.

Compartmentalization of total body water varies with age; electrolyte composition remains relatively stable.

| | Na+ | K+ |
|---------------|---------|----------|
| Intracellular | 10 mEq | 150 mEq |
| Extracellular | 140 mEq | 4.5 mEq. |

Deciding how much the maintenance requirements are for any child can be based on relatively simple formulae, which vary according to metabolic and physical activity.

The basis for water utilization in caloric expenditure under normal conditions at bed rest is the following:

| | |
|-------------|------------|
| 0 to 10 kg | 100 cal/kg |
| 10 to 20 kg | 50 cal/kg |
| > 20 kg | 20 cal/kg. |

(Increase 12% for each degree centigrade above normal and increase 0% to 50% for varying increased activity or metabolic rate.)

The calculation of water loss per calorie can be based as follows:

| | |
|-----------------|-----------------|
| Urine | 55 mL/100 cal |
| Insensible loss | |
| via lungs | 15 mL/100 cal |
| via skin | 30 mL/100 cal |
| Adding up to | 100 mL/100 cal. |

Therefore, with mL proportional to cal, the following correspondences exist:

| | |
|-------------|-----------|
| 1 to 10 kg | 100 mL/kg |
| 10 to 20 kg | 50 mL/kg |
| > 20 kg | 20 mL/kg. |

As an example, the following are maintenance water requirements for a 17-kg child at bed rest with normal temperature and metabolism:

| | |
|-----------------------------------|---------|
| first 10 kg = 10 kg x 100 mL/kg = | 1000 mL |
| second 7 kg = 7 kg x 50 mL/kg = | 350 mL |
| total | 1350 mL |

maintenance water requirement every 24 hours.

The following are maintenance electrolyte requirements:

3 mEq Na⁺/100 mL H₂O
2 mEq K⁺/100 mL H₂O.

Discussion of complex deficits has not been undertaken in this chapter; in most cases these problems require pediatric medical assistance.

Pain Management

It is commonly believed that newborns and infants do not experience pain because of their immature nervous systems, and that they do not have any memory of pain if it does take place. Currently we know that the neurophysiologic pathways for nociceptors *are* developed in premature babies, and that newborns respond to noxious stimuli with well-categorized behavioral and physiologic changes suggestive of substantial stress and distress.

Pain certainly is both a sensory and an emotional experience that may be altered by various psychologic factors. These factors may be specific for each individual based on the individual's expectations and past experiences. It is clear that many of the procedures performed in the office, and certainly in the surgical suite, will induce pain in children. A management plan must be used in order to reduce this pain. Efforts to reduce stress, anxiety, and fear, which commonly amplify the pain experience, can be expected to decrease the distress associated with acute or chronic pain. In patients of the appropriate age relaxation techniques including guided imagery, breathing techniques, and hypnosis may diminish the emotional component of pain.

Nonnarcotic analgesics such as acetaminophen in doses ranging from 10 to 15 mg/kg orally every 4 hours are useful in patients of all ages. In older children and adolescents ibuprofen 4 to 8 mg/kg per dose every 6 hours, and naproxen 5 to 7 mg/kg every 8 to 12 hours may be more effective than acetaminophen.

Narcotic analgesics are indicated for moderate to severe pain in patients of all ages; however, optimal use requires consideration of the needs of the individual patient. Neonates require special care in the administration of narcotics. They have diminished ventilatory responses to hypoxia and hypercarbia, and also have pharmacokinetic differences that include prolonged elimination half-life, diminished clearance, and increased permeability of the blood-brain barrier. The use of oral narcotics for postoperative pain may be safe when used in the appropriate dosages and if signs of toxicity are monitored carefully.

Sedation

The use of sedation for outpatient examinations including CT scanning, MR scanning, and audiologic evaluations is becoming increasingly common. This in itself is not dangerous; however, preparations for complications secondary to the use of sedation should be made in advance. A simple agent such as chloral hydrate may, in a patient with large tonsils and adenoids, produce intermittent obstructive apnea requiring active airway management. The use of midazolam, diazepam, or other more potent sedative agents may produce apnea or respiratory depression requiring positive-pressure ventilation with oxygen. Any office or radiologic suite that uses sedation to facilitate examinations of children should be prepared for the resultant complications.

Referral Sources

Pediatric patients are referred in a variety of ways: as members of a family previously treated, as friends of other patients who are satisfied with services the physician has provided, or as referrals from other physicians. By far the most common referral source is pediatricians. Pediatric medicine is a specialty that legitimately considers itself to be the child's advocate. It is also a specialty that has earned the respect given to any group representing a special body of knowledge within the field of medicine. The pediatrician may serve as a consultant for preoperative planning or postoperative management for children with complicated illnesses, such as endocrine or other metabolic disorders; psychiatric problems related to that particular patient, or inter-family difficulties that may affect the patient's reaction both to surgery and the hospital experience.

A delineation of duties should always be established between the otolaryngologist and the referral source. All concerned must understand that the surgeon is ultimately responsible for the care of any patient undergoing surgery; a decision to proceed with surgery should, however, always be accepted by the parent as well as by the referral source. Difficult situations can sometimes arise when the patient or parents have been led to believe that a certain surgical procedure will be performed before they have discussed the issue with the surgeon. In these cases, how a decision has been made must be explained in a clear and logical manner; all must clearly understand the steps leading to that logical conclusion. Mutual respect, open lines of communication, and a sincere desire to do what is best for the patient involved should allow for a best possible result from the management of any pediatric head or neck disorder.

Patients

Children are certainly different from adults, not only in age but in maturity, shyness, and so on. All children, however, must be allowed the same rights, dignity, and respect given to adults.

The first thing I try to accomplish when entering the examination room is to establish some rapport with the child, not by approaching him immediately, but by introducing myself to the parents and the child in a friendly and open manner. Whether a neonate or an adolescent, he needs to understand that the physician is not someone who is going to inflict pain or punishment but, instead, someone who is going to help him feel better. Once an introduction has been made, the patient can generally be involved in a conversation regarding siblings, pets, or activities at home - which puts him further at ease and allows the physician to continue the examination. Seeing the clinician involved with the child also puts the parents at ease and allows them to be comfortable during their initial contact with the physician. The child is always examined with the parent in the room and, in the case of an infant or young child, sitting on the parent's lap if possible. Sometimes at the request of the patient, the parents are asked to leave the room; this is, however, unusual. Most children are more secure with family present.

The physician continues to engage the child in conversation during the examination, explaining to him in advance everything that is going to happen to him in a clear and straightforward way. If a particular portion of the examination is uncomfortable or unpleasant,

delaying it until the end is preferable. In some cases the child may be excessively frightened or crying, and completing an examination may be impossible. If this is the case, and the child is old enough to reason with or remember the experience, the preferred approach is usually to ask the parents to return with the child at another time to try and repeat the examination. If the patient is an infant or young child, proceeding with the examination as speedily as possible is preferred. Quickness and experience allow one to perform a brief but relatively complete examination without undue stress on the child or parent. Restraining an older child who may be traumatized by a forceful examination is wrong and possibly dangerous. If necessary in these cases, sedation may be used to complete the examination.

Parents

The parents of an ill child are already under a significant amount of stress, and it can sometimes be difficult to deal with them. A great deal of experience is needed to be able to allay fears and misconceptions regarding the nature of their child's illness and surgery, if it needs to be performed. Fortunately, in most cases a referral source has named a physician as an expert who can deal with their child's problem. In addition, at the initial meeting with the parents and child, an ability to establish a rapport quickly with the child fills the parents with additional confidence in the specialist's skills.

Allowing additional time is advisable when dealing with new patients and their parents so that one can give complete explanations as to the nature of the illness, the prognosis, the way in which surgery is technically performed, and the expected outcome. The child is allowed to stay in the room during this explanation to allay any fears that he might have regarding an upcoming hospitalization. During this discussion it is important not to commit an anesthesiologist or another consultant to a decision; one would not like the referral sources to do so for oneself.

At the end of the meeting the parents should clearly understand the need for surgery and agree to its being performed. This is easily accomplished in emergency situations in which choices are limited, but in elective cases it may be more difficult for parents to commit their child to a surgery that undoubtedly has risk associated with it. The guilt over making such a decision can be difficult to overcome, and the surgeon must not place himself in the position of persuading the parents to allow their child to undergo surgery. All preexisting notions about any upcoming surgery are colored by a friend's or relative's experience, and the surgeon must understand that experience to combat any misconceptions that might arise about the surgical procedure. Urging patients to consider a decision at home and to call back if they want to schedule surgery is advisable.

Congenital abnormalities

When dealing with children who have congenital abnormalities or sensorineural hearing loss, a physician must be very careful in approaching the parents so as not to present information contradictory to what they have already heard from their primary care provider. Most parents of a child with a congenital abnormality have unexpressed guilt related to their child's maldevelopment, which can lead to anger, confusion, and denial on their part.

Explaining as clearly as possible the origin of any abnormality, its eventual prognosis,

and the fact that quick and easy solutions are generally not available is important. Parents should understand that problems must be faced as they arise, and difficulties encountered must be shared with the physician and other health professionals; the physician, as a consultant, will thus be able to correct or help them adapt to their child's difficulty.

At one time genetic counseling was routinely advised for all children with congenital abnormalities. Currently the feeling is that genetic counseling should be offered only to the parents who desire it. Other than speaking in general terms of the inheritable nature of sensorineural deafness, cleft palate, and so on, the physician should not force the parents to face information that they do not wish to acknowledge. The denial phase is related to their eventual acceptance of the child's problem; once they have adapted to the child's congenital abnormality, the parents are much more receptive to genetic counseling.

The parents should understand that any developmental or hereditary abnormality generally requires a team of physicians or health professionals to evaluate and manage. A child with a cleft lip or a cleft palate needs, in addition to a surgeon's expertise, speech therapy, audiometric evaluations, and dental care to provide for optimal remediation. In more complex craniofacial abnormalities, additional people are required for the best result and may include a neurosurgeon and a plastic surgeon in addition to the pediatrician or developmentalist who can make sure that appropriate milestones are being reached.

History

The history is generally obtained from the parent accompanying the child. Hearing events as they occurred in the parent's own words is important, commencing with the first symptom or problem. To accept the diagnosis made by another physician is all too easy and, unfortunately, sometimes wrong. Further questioning of the parents and child elicits additional specifics regarding the illness. Parents are generally extremely astute regarding the symptoms that their child develops during the course of an illness, and their comments should be taken at face value and not be disregarded. Also, children may have difficulty expressing their complaints but should be believed until their symptoms can be properly defined.

A general family history is important to obtain, as well as a history of any diseases or illnesses affecting siblings. Information regarding the pregnancy and delivery of the child should be obtained along with, if possible, some insight into any family stresses or school problems that might be influencing the child's psychosocial development.

Physical Examination

After the surgeon has established himself as a nonthreatening person, the physical examination is often accomplished quite easily. Otoscopy is generally managed without any difficulty, especially after one explains that the otoscope is merely a light used to look in the ears. Sometimes one uses insufflation to check the movement of the tympanic membrane; this should not cause any discomfort or pain. The nasal examination is accomplished with the otoscope and a larger speculum than the traditional nasal speculum, which is a fearful object to some children. The oral examination is best accompanied without a tongue depressor; using a tongue depressor may be necessary, however, to view the posterior pharynx in some children. Palpation of the neck can be accomplished without significant discomfort, and any

notation of masses or tenderness can be made. During the examination further observation of the child's facial features can be made, making sure that ears are of normal appearance, that no preauricular pits or other fistulas are present, that the eyes are symmetric, and that no apparent hypertelorism exists. Also one should check that the external nose appears to be within normal limits, that the child is breathing adequately through the nose and does not seem to be a chronic mouth-breather, that no abnormalities exist within the palate, that no dental abnormalities exist, and that the patient seems to be breathing easily and without stridor. Auscultation of the neck and chest is generally performed, and any obvious deformities of the extremities, abdomen, and so forth are searched for. The otolaryngologist - head and neck surgeon certainly concentrates the physical examination on the particular area of interest, which is the head and neck; however, a general examination should be performed, in a brief but complete manner.

Special considerations

Microscopic examination of the ear

On the initial visit, every patient is subjected to a microscopic examination of the ear. Details regarding the condition of the tympanic membrane, its movement, and the presence of any fluid or infection can be more accurately determined by the otomicroscope than by any other means. It is also the best means available to assist the physician in cleaning the ear of debris and wax to allow for more complete visualization. Most children permit a microscopic examination of the ear once they are told that the machine to be used is merely a light with a magnifying glass. Again, the parents are present during this examination and sit right next to the child and, in some cases, help to hold the child's hands or head still so that the examination can be accomplished without difficulty. Parents can generally hold infants sufficiently still to permit microscopic examination. For the 18-month-old baby who is difficult to restrain, a papoose board is sometimes necessary. Continuing to allow the parents to hold the head still and to be able to comfort the child should he be nervous or frightened is advisable. Larger children who cannot be successfully restrained on a papoose board should be asked to return for another examination when they have been desensitized to the microscope. Sedation is not usually successful but may be tried in certain cases. A general anesthetic may be needed for complete examination and evaluation.

The suction used to clean the ear is sometimes especially frightening to young children, and rather than using a suction, the physician sometimes finds it less traumatic to use a cotton wisp to absorb any discharge present in the ear. In all cases, extreme care must be taken because once the ear is injured, the examination can no longer be completed.

Flexible endoscopy

The small-caliber flexible endoscope is used quite often in pediatric practice for the evaluation of stridorous infants or children with voice disorders or speech problems. Although in some cases a mirror can still be used in older children and adolescents, performing an adequate laryngeal examination with a mirror in younger children is very difficult. The flexible endoscope permits visualization of the larynx of young infants and children and also allows a dynamic view of the pharynx, velum, and hypopharynx, adding a new dimension to the evaluation and treatment of disorders affecting these structures.

In infants and young children, anesthesia can be easily obtained with either lidocaine (Xylocaine) gel or 2% lidocaine drops placed in the nose with an eyedropper. The nose must first be examined to make sure no septal deviation or obstruction lesion exists that would prevent the passage of a small telescope. Using cocaine in young children is not advisable because of its variable absorption rate. In infants it can produce unwanted symptoms of irritability and nervousness. Parents should be carefully cautioned that after anesthesia has been obtained in the nose and pharynx, the child should not feed for approximately 30 to 40 minutes and should try feeding only slowly at that time. Sedation is not generally necessary for this examination; instead, the endoscope can usually be used quickly on infants to evaluate without serious stress or consequences. The neonate may require some restraint; a towel may be used to bundle the infant, or someone may have to hold the patient's head still. Generally, in children 3 years or older a careful explanation of what is about to happen, with assistance from the parents, is all that is necessary to complete the examination successfully or obtain their cooperation with it. For cases in which cooperation is lacking, the individual practitioner must decide whether to proceed.

Complications using the flexible endoscope in the examination of children are rare; however, within the examination space, an emergency cart should be available for intubation or emergency therapy, should it become necessary. If one is to be actively involved in the examination and treatment of childhood disorders, having instruments for intubation and resuscitation of small children nearby is certainly reasonable, in case any catastrophic event occurs that necessitates ventilation, administration of drugs, or cardiac stimulation.

Needle biopsy

The fine-needle aspiration technique used to evaluate neck or facial masses further is just as useful for children as for the adult population. If a cytopathologist is available and interested in reading specimens, the adjunctive value in diagnosis can sometimes prevent the need for an open biopsy.

Children are quite frightened of all needles or sharp objects; however, a 22- or 23-gauge needle can usually be passed into a neck mass or facial mass without complication. The procedure is carefully explained to the child, and the child is restrained. The area is prepared with a povidone-iodide (Betadine) solution, and the needle, with a 10-mL syringe, is then placed into the mass while the syringe is aspirated. The sample thus obtained within the needle core is placed on a slide, which is then wiped on another glass slide and placed in a fixative. A Band-Aid is used to cover the puncture wound. The procedure is generally no more traumatic than the obtaining of a blood sample and should be explained in those terms to parents.

Audiology

Every child, no matter what age, can be tested for hearing loss. Pediatricians or other referral sources, who tend to delay early diagnosis and referral, often overlook this fact. Parents are, however, generally acute observers. If their child does not seem to hear, or somehow seems different from other children, the physician should give credence to their thoughts and suggestions and obtain a hearing test for that particular child.

Using brainstem-evoked response audiometry is certainly not a necessity for every surgeon. If, however, the pediatric population makes up a large proportion of the patients seen, visual-response audiometry is a very helpful means, in addition to routine audiometric evaluation and tympanometry for the testing of children. Infants 6 months or older can be behaviorally conditioned to respond visually to stimuli at certain sound levels. These responses are extremely reliable and can be used in experienced hands to determine the level of hearing and the need for further diagnostic testing.

Early identification of hearing loss in children is of the utmost importance for safeguarding their eventual verbal and language abilities. Maintaining a high-risk register of infants and children who have risk factors associated with hearing loss can aid the practitioner and parents in identifying the children who may have a hearing loss and who would benefit by early intervention.

Functional disorders

Somatization of stress within childhood and adolescence is not uncommon. Every child who is evaluated with a complaint is assumed to have an organic basis for his problems. In some cases, however, one can clearly determine that a functional disorder exists; and although an organic cause may stimulate the chief complaint, no problem exists at the time of examination. In cases of hearing loss in which the Stenger test is positive or in which the patient is aphonic and yet has mobile vocal cords, direct confrontation is not advisable. Instead, a search should be undertaken for causes of the complaint in the family, school, and extracurricular activities. Sometimes relying on the primary-care provider, school counselor, or other counselor to delve completely into the situation is preferable, although the parents must always be informed as to the nature of the child's complaint and its possible causes.

Preparation for Hospitalization and Surgery

Once the decision to proceed with the hospitalization or surgery has been made, emotional preparation of the child and parents also must take place for a successful result. Having already discussed the surgery in factual terms, the surgeon has laid important groundwork for that preparation. The surgeon or a nurse familiar with all aspects of the surgical procedure should undertake careful explanation of all details of the hospitalization. Admission to the hospital, venipuncture, injections, the withholding of food and drink, transport to the operating room, and the induction of anesthesia must all be discussed to allay fears or misconceptions that may arise on the child's part.

A tour of the hospital, including the patient stay areas and operating rooms, and an introduction to nurses and other staff is helpful in eliminating the fear of the child who is coming to the hospital. Special motion pictures and booklets are also of value in reducing the concern about upcoming hospitalization. The parents must be encouraged to be truthful, to the best of their ability, about any upcoming surgery. It is important for the physician to communicate enough about a hospitalization or surgery to the parents and to the child so that questions may be answered completely.

The Hospital

A children's hospital within the community is a great asset, providing a team of physicians, nurses, and other staff who can best handle the hospital stay or surgery for the pediatric patient. These children's hospitals are an important resource, and every surgeon involved in pediatric practice should support them. If a facility for children is not within the area, a search for the hospital best able to provide care and support for pediatric patients should be undertaken. The hospital must be able to provide services that make the patient's experiences the best possible and also allow for the greatest safety in that patient's preoperative, surgical, and postoperative management.

The concept of a team of professionals who deal strictly with pediatrics is not new; it is, however, one that is becoming increasingly accepted as the standard of care. When complications arise, as they inevitably do in the course of medical practice, having support facilities and personnel available to handle the needs acutely is vital.

Selecting anesthesia

Pediatric anesthesia is a subspecialty in itself. Reaching a degree of proficiency for delivering anesthesia to young children requires considerable time and experience. The younger the infant and the more complex the problem that must be dealt with, the more specialized are the techniques that must be used. Without question some anesthesiologists are better trained and more comfortable in dealing with the challenging aspects of pediatric anesthesia. Reliance on those individuals reaps benefits for both the patients and the surgeon.

Local anesthesia is generally not used in young children because of their inability to understand the need for painful injections and the like. Most children's short attention span makes them unlikely to remain still and quiet. The use of sedation for extended periods of time in elective procedures is probably not advisable, unless support personnel can monitor the child carefully and make sure that he does not develop sequelae related to the sedative being given.

One notable exception is the use of iontophoresis for myringotomy. Iontophoresis is generally a safe technique that is at least 90% effective, in a cooperative child, for achieving adequate local anesthesia of the tympanic membrane so that a myringotomy or tube placement can be accomplished without too much difficulty. It cannot be accomplished through an infected or markedly thickened eardrum, and it should not be used in a child who is unable to hold still or cooperate for a microscopic examination. The 4- to 5-year-old patient is generally the youngest child for whom this procedure can be performed. Having the parents remain next to the child and provide support can make all the difference in the ultimate success of the procedure. Obviously, the surgeon must have confidence in his technical ability to perform a myringotomy without injuring the external canal, because anesthesia is obtained only in the eardrum.

Postoperative management

The most important aspect in postoperative management is having the parents and child well prepared for the effects of surgery and the recuperative period with clear, well-

detailed instructions as to normal and abnormal occurrences, level of activity, diet, and so forth. Without detailed teaching and written instructions, postoperative management of even simple problems is confusing to the parents who are concerned about the postoperative difficulties that their child may encounter. Knowing what to expect is the single most important factor that enables the patient to recover from a surgical procedure without multiple phone calls from the parent and excessive concern from both parties.

It has been clearly demonstrated that when children have to remain in the hospital for either medical or postsurgical treatment, the presence of their parents makes the hospital stay less fearsome and less troublesome. If possible, arranging for a parent to stay with the child during the hospital admission is wise to provide the security necessary for a rapid recovery. Without question the briefest possible hospital stay is best for the child and least expensive for the parents. Short-stay surgery is being extensively used to manage the procedures in pediatric otolaryngology that require minimal in-hospital care. Myringotomies, tonsillectomies, adenoidectomies, and minor ear surgery can easily be performed in a short-stay surgical suite, allowing for early discharge from the hospital and recuperation at home.

Remembering that modifications in surgical technique must take place in the treatment of pediatric problems is important. Dressing changes, suture removals, and postoperative manipulations should be kept to a minimum so as not to provoke fear and discomfort in the child who must undergo minor procedures. Sometimes sedating a child is necessary for removal of packing or sutures, which would certainly be unnecessary in an adult. It is reasonable then to plan ahead at the time of surgery and to use absorbable sutures, dressings that need to be removed only once, and few manipulations.

Summary

Since each child is an individual, each child's care should also be special and individually tailored to that child. The extra effort required to learn different techniques and different approaches is necessary for the physician who is interested in providing care to children. The practitioner who takes the trouble to provide special care and services to children will reap benefits and satisfaction.