**PART I**

**EXAMINATION OF THE RESPIRATORY SYSTEM**

**EARS, NOSE, THROAT, NECK, AND ORAL EXAMINATION AS PART OF THE RESPIRATORY SYSTEM EXAMINATION**

Of the entire general pediatric examination, the ears, nose, head, and neck are universal and yield the most information.

**EAR**

Examine the position of the ear relative to the eye level. Low-set ears (in which the entire auricle sits below the level of a line drawn between the canthi of both eyes) are associated with several *genetic* syndromes involving respiratory system. Major defects of the external ear can be associated with underlying hearing loss. Minor malformations are common and benign. *Infections* can occur in *preauricular pits* if they connect to *branchial cleft cysts.*

The otoscope is the best instrument to examine the canal, tympanic membrane, and middle ear. Choose the largest ear speculum that will fit in the canal in order to obtain a good seal. Inspect the canal as you insert the speculum for foreign bodies, localized findings on the walls (e.g., *furuncles* and *vesicles), edema*, or mucopurulent discharge. Cerumen commonly accumulates in the outer portion of the canal.

The tympanic membrane is bulging outward in *acute otitis media,* obscuring the bony landmarks of the manubrium; when middle ear pressure is negative, the membrane retracts, and the short process of the manubrium can look more prominent.

The normal tympanic membrane is translucent—one can see bony landmarks well. A dull membrane can be associated with acute infection or chronic scarring.

**MOUTH**

The tongue is easy to examine in the infant, but it is frequently necessary to use a tongue depressor to visualize the hard and soft palates and the posterior pharynx. One has to be quick with this maneuver because the infant frequently will gag and regurgitate, obscuring the view.

**EXAMINATION OF THE FACE AND MOUTH**

Look for obvious asymmetry or defect such as a cleft lip? Is the mandible small (micrognathia) or retracted (retrognathia)? Note any unusual odors, is the breath fetid or sweet-smelling? Halitosis can be a sign of foreign bodies in the nose, *dental* or *tonsillar abscesses,* or *sinusitis.*

Examine the tongue. *Fissured tongue* is a developmental anomaly featuring a prominent midline anteroposterior fissure from which smaller fissures radiate laterally. It occurs more frequently in adults than in children but is a common finding in children with *Down syndrome. Ankyloglossia*

is a short lingual frenum that attaches the dorsum of the tongue to the floor of the mouth. This condition is rarely severe enough to require surgical intervention unless the infant has difficulty feeding. Absence of both the lingual and mandibular labial frenula is associated with (1) Ehlers-Danlos syndrome and (2) pyloric stenosis. *Inflammatory* conditions such as *Kawasaki disease* or streptococcal infections may cause prominence of the papillae, the so-called strawberry tongue. In contrast, atrophy of the papillae will give the tongue a smooth appearance. When uniform, this is *glossitis. Geographic tongue* demonstrates irregular, pink, slightly depressed areas with elevated white or yellow borders. The lesions represent areas of flattening and desquamation of the filiform papillae and occur on the dorsum and lateral borders of the anterior two-thirds of the tongue. These lesions are typically asymptomatic but may on rare occasion be painful.

Cleft lip or micrognathia (the *Pierre-Robin sequence*). A subtle *submucous cleft palate* is often hard to find and can present only with thinning of the midline of the palate or a bifid uvula. A high arched palate is a minor malformation that can occur alone or in association with various *congenital* syndromes. It also may be secondary to *trauma* from prolonged intubation.

The size of the tonsils may be graded from 1+ to 4+, with 1+ tonsils lying entirely within the pillars and 4+ tonsils touching in the midline.

**PART II**

**CHEST**

Observe abnormalities of chest conformation or the thoracic spine on first inspection. Absence of the pectoralis major muscle unilaterally indicates *Poland syndrome* (anomalad).

Rib or thoracic vertebral anomalies (e.g., hemivertebrae) lead to chest wall asymmetry. Increased anteroposterior thoracic diameter is present with airway obstruction and early, severe neuromuscular disease (e.g., *type I spinal muscular atrophy*) and may cause a small thoracic cage and diminished intercostal musculature. Pectus deformities of the anterior chest wall begin to become evident at early infancy, but unless severe, they become increasingly more noticeable with age.

Observe respiratory rate because increased respiratory rate is often a first sign of pulmonary disease in infants. Observation of rate, rhythm, and respiratory pattern is important. Depth of respiration and frequency will change significantly during sleep state and activity, and infants and young children have a particularly wide range of normal values (FIGURE). Because of this wide range and variation, counting respirations for a full minute on at least a couple of occasions is best practice. *Tachypnea* (abnormally high breathing frequency) is found in metabolic conditions such as fever or acidosis, anemia, and congenital heart disease, as well as viral or bacterial infection. *Hyperpnea* (abnormally deep respirations) may accompany metabolic conditions such as acidosis. *Hypopnea* (abnormally shallow breathing) can occur in CNS disease or in sleep-disordered breathing. Pattern of breathing is important to observe in this age group. Short respiratory pauses of less than 10 seconds occur frequently in infants in the first few months of life. If separated by less than 20 seconds, they are termed *periodic breathing* and are found in normal newborns, older premature infants, and some infants with developmental disabilities stemming from CNS dysfunction (e.g., *perinatal asphyxia*). True *apnea* (pause > 20 seconds), with or without cyanosis and/or bradycardia, is rare but is reason for immediate evaluation and intervention. Because of the highly compliant chest wall and more horizontal orientation of the diaphragm in infants and young children, increasing respiratory effort manifests as inward drawing of the chest wall termed *retractions.* Head bobbing and suprasternal retractions are good indicators of upper airway obstruction, and intercostal and subcostal retractions are good indicators of lower airway obstruction. Flaring of the alae nasi (nasal flaring) occurs frequently in newborn and young infants accompanying increased work of breathing and is often present along with retractions and tachypnea. Seesaw respirations, i.e., drawing in of the chest wall with outward motion of the abdomen, occurs during inspiration in young infants with highly compliant chest walls. In any young child, this pattern of paradoxical breathing can be ominous and may indicate impending respiratory failure. Extrathoracic inspection is vital to the complete pulmonary assessment. Concavity of the abdomen may indicate the presence of diaphragmatic hernia, and protruding abdominal masses or weakness in the abdominal musculature may prevent or impede diaphragmatic excursion, leading to respiratory distress. Birth trauma, especially with the use of forceps or with difficult presentation with manual extraction, can lead to unilateral *phrenic nerve trauma* with subsequent asymmetric diaphragmatic excursion. This appears as differential chest wall excursion or paradoxical abdominal movement.

Observe the fingers and toes for evidence of digital clubbing. Clubbing is rare in infancy and generally becomes evident in early childhood, associated with chronic pulmonary, cardiac, or hepatic disease. Since it is a more prominent sign in older children, there is a more intensive discussion in later sections.

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**FIGURE: Normal Respiratory Rates by Age.** Because of the high variability of rates in young infants, it is necessary to count rates for a full minute. (Adapted with permission from Chernick V. Boat TF, Wilmott RW, Bush A (eds): Kendig’s Disorders fo the Respiratory Tract in Children, 7th ed. Philadelphia: Saunders-Elsevier, 2006.)

*Palpation* often confirms findings on inspection of the head and neck, chest wall, and abdomen and is an essential component of the complete pulmonary examination. Examining the neck for masses and determining correct position of the trachea are important. A finger placed in the suprasternal notch in infants should reveal a normal slightly right deviation of the trachea. Palpation of the thoracic often will reveal rib anomalies as a cause of chest asymmetry. During crying, the transmission of airway vibrations decreases with the presence of significant thoracic masses, fluid accumulations, or consolidation. Evaluate this by placing the hands on each side of the chest wall. Palpation of the abdomen is essential because masses and enlarged organs limit diaphragmatic excursion and lead to respiratory compromise. The absence of palpable upper abdominal organs in the face of a scaphoid abdomen leads the examiner to suspect *herniation* of the abdominal contents into the thorax, requiring emergency intervention.

Auscultation of the chest and upper airway is an important adjunct to other aspects of the respiratory tract examination. Evaluate respiratory sounds for intensity or amplitude, pitch of lung sounds, and timing during the respiratory cycle. Lung sounds are named by use and convention. They are the same in infants, children, and adolescents and are summarized in TABLE.

Auscultation of the infant chest is often a challenge owing to limited cooperation and high respiratory rates. Some useful suggestions:

**TABLE *CHARACTERIZATION OF LUNG SOUNDS***



***Tips for Performing the Respiratory Examination on Infants and Children***

1. Perform the examination in a warm, well-lit room with a minimum of noise distraction.

2. Do as much of the examination as possible with the child on a parent’s lap.

3. Warm instrumentation is essential.

4. Quiet breathing is best heard during feeding or with use of a pacifier.

5. Lung sounds are best heard during the inspiratory portion of a deep breath during crying of the infants.

6. Guard the privacy of adolescents with proper draping and gowns, as well performing the examination without parents present.

7. The passive examination is always the best, e.g. decubitus x-rays for foreign-body aspiration, supine positioning to bring out wheezing in infants, examination during sleep, etc.

A hoarse and muffled cry usually accompanies any vocal cord weakness. Snoring occurs most often in a supine position and in young infants usually accompanies nasal obstruction, although a good pharyngeal examination to rule out hypertrophy of tonsillar tissue or masses (e.g., *thyroglossal duct cyst*) is important. Grunting occurs primarily in premature and very young infants and represents partial closure of the glottis during expiration to maintain positive end-expiratory pressure. This helps to avoid early closure of small, inflamed airways toward the end of expiration and helps to maintain alveolar stability in the case of surfactant deficiency. Wheezing is primarily expiratory and reflects turbulent airflow in tubular structures of the lower (intrathoracic) airway. With increasing airway obstruction, the wheeze may become biphasic, i.e., heard during both inspiration and expiration.

The stethoscope is still a useful tool to assess the location and character of lung sounds. Because of the relatively thin chest wall of small infants, transmission of airway sounds can occur widely and may be somewhat more difficult to localize. Use of the diaphragm of a stethoscope head that is able to fit between the ribs over the intercostal muscles can help in this effort. Deep inspirations are important to assess local lung sounds. In young infants, these occur during the deep breaths taken during crying. Position may affect differential lung sounds, and a straight posture is important. It is best to examine young children on the mother’s lap, although the supine position may bring out wheezing better than the upright position. Symmetric auscultation of all lung segments to assess for the presence of crackles, as well as decreased intensity and change of pitch (often during crying), will help to localize areas of consolidation. Coarse central expiratory (or biphasic) wheeze usually reflects airway lesions such as tracheomalacia, and peripheral and diffuse wheeze indicates small airways disease (e.g., asthma or bronchiolitis). Asymmetric wheeze always should alert the examiner to the possibility of a foreign-body aspiration at any age. Auscultation over the head and neck can be useful in localizing upper airway obstruction.

*Percussion* of the chest wall assesses acoustic response to a vibratory force applied to lung tissue. The technique requires practice and consists of tapping of the middle finger of one hand with the middle finger of the other while it is applied to the chest wall. It is essential that one does this symmetrically and that the response is assessed for resonance (hollowness) and dullness (flatness). This is often not useful in young infants and frequently will elicit poor cooperation and crying. The technique is of more use in older children.