Laryngomalacia and Tracheomalacia: Common Dynamic Airway Lesions

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In Brief

Laryngomalacia, the most common cause of stridor in infants, results from the collapse of supraglottic structures (such as the arytenoid cartilages and epiglottis) during inspiration. Normally, laryngeal structures are sufficiently rigid to maintain glottic patency during inspiration. In the infant who has laryngomalacia, however, “floppy” laryngeal structures allow their own collapse during inspiration, when the relative airway pressure is negative and the movement of air is inward. Because the abnormality is not fixed, the obstruction is relieved during expiration, when the relative airway pressures are positive and the flow of air is outward. As such, the hallmark of laryngomalacia is inspiratory stridor. Depending on the severity of the abnormality, the stridor may be minimal during quiet breathing, but exacerbated with crying or agitation. In addition, placing an infant in the prone position may diminish the stridor. In addition, placing an infant in the prone position may diminish the stridor.

Although laryngomalacia can be diagnosed most often by history and physical examination, direct visualization of the glottis may be needed to exclude a fixed lesion such as a laryngeal web or subglottic stenosis. With malacia, laryngoscopy demonstrates collapse of the arytenoids or epiglottitis on inspiration and opening of the glottis on expiration (Fig. 2). Direct visualization also may reveal an omega-shaped epiglottitis, a common finding in patients who have laryngomalacia.

Although the intermittent stridor of laryngomalacia may be distressing to parents, it rarely leads to life-threatening obstruction and usually can be managed with close observation alone. In fact, most cases of isolated laryngomalacia resolve spontaneously in the first postnatal year. More severe cases, however, may result in growth failure from the increasing energy the affected infant expends to maintain adequate ventilation. The primary care physician must monitor closely and refer any child who has stridor and inadequate weight gain to an appropriate subspecialist. In such cases, surgical intervention (excision of arytenoid mucosa, shortening of the aryepiglottic folds, suspension of the epiglottis, tracheostomy) may alleviate the obstruction and promote normal growth.

Although most cases of laryngomalacia are congenital, others have been associated with a variety of clinical conditions, such as gastroesophageal reflux disease, neuromuscular weakness, or multiple congenital abnormalities. Identification of such conditions is important and may help guide management, particularly when gastroesophageal reflux is present.
geal reflux coexists, because aggressive antireflux treatment may improve symptoms.

Similar to laryngomalacia, tracheomalacia results from a weakness of the airway cartilage that results in “floppiness.” However, the clinical manifestations of tracheomalacia reflect the predominantly intrathoracic location of the trachea. Compression of the thoracic cavity during expiration results in positive intrathoracic pressures, which are transmitted to the airway structures. Under normal circumstances, the cartilaginous rings supporting the anterior three-quarters of the trachea prevent airway collapse during passive, or even forced, expiratory maneuvers. In the infant who has “floppy” tracheal rings, however, these positive intrathoracic pressures can cause the trachea to collapse on itself and obstruct airflow during expiration. During inspiration, when negative intrathoracic pressures tend to “pull” airways open, the obstruction often is relieved. The hallmark of tracheomalacia is an expiratory wheeze, although patients can have a variety of other symptoms, ranging from a mild cough to life-threatening “death spells.” The wheeze heard in tracheomalacia sometimes is difficult to distinguish from that heard with other diseases characterized by wheezing, most notably asthma. Although both tracheomalacia and asthma exhibit expiratory wheezing, the wheeze heard in tracheomalacia often is central, low-pitched, and homophonous; wheezing heard in asthma tends to be diffuse, high-pitched, and musical. Although the wheezing associated with asthma should respond to beta-agonist therapy, that of tracheomalacia remains unchanged or even worsens after administration of beta-agonists. Finally, placing an infant who has tracheomalacia in the prone position may alleviate the symptoms because gravity pulls the mediastinal structures anteriorly, thus opening the airway.

As with laryngomalacia, the diagnosis of tracheomalacia often is reached after a history has been taken and a physical examination performed. However, a number of diagnostic modalities can help confirm the diagnosis and

![Figure 1](image1). Airway pressures during respiratory cycle. During inspiration, expansion of the thorax creates negative pressure within the thoracic cavity and airways (black arrows), allowing inflow of air (blue arrow). Thus, a weakness in the extrathoracic airway (red arrow) is likely to be symptomatic during inspiration. During expiration, compression of the thorax creates positive pressures within the thoracic cavity and airways (black arrows), allowing outflow of air (blue arrows). Thus, a weakness in an intrathoracic airway (red arrow) is likely to be symptomatic during expiration.

![Figure 2](image2). Laryngoscopic findings in laryngomalacia. During inspiration, the epiglottitis (arrows) collapses onto the glottis and obstructs the airway. The obstruction is relieved with expiration.
exclude other lesions, such as vascular rings or mediastinal masses, that can cause airway compression. A simple chest radiograph can identify a mediastinal lesion, and an esophagram can demonstrate airway compression from a vascular ring. Airway fluoroscopy is a noninvasive method for confirming the dynamic airway compression that occurs in tracheomalacia, and fiberoptic bronchoscopy is used increasingly to characterize these lesions more clearly (Fig. 3).

Tracheomalacia can present as an isolated congenital lesion or in association with other clinical entities, most notably, tracheoesophageal fistula and trisomy 21. When associated with tracheoesophageal fistula, tracheomalacia can remain problematic despite repair of the fistula. Although many cases of tracheomalacia are congenital, the condition can be acquired. Tracheomalacia is a known complication of chronic mechanical ventilation because high ventilator pressures may contribute to the weakening or destruction of tracheal cartilage. In addition, tracheomalacia is recognized increasingly in patients who have bronchopulmonary dysplasia.

Although many patients who have isolated tracheomalacia can be managed with only close observation for adequate weight gain, others may benefit symptomatically from a variety of therapeutic measures. Bethanecol, a cholinergic agent that can increase smooth muscle tone in the airways and, thus, strengthen the trachea, is not used widely, but it has been shown to increase expiratory flows in a small number of patients who have tracheomalacia. Ipratropium bromide has been used similarly. However, severe obstruction leading to growth failure or causing repeated “death spells” may require more invasive intervention. Nasal continuous positive airway pressure can help maintain airway patency temporarily; aortopexy or tracheostomy can provide long-term relief of obstruction. Finally, potential coexisting conditions such as gastroesophageal reflux, which may aggravate the signs associated with tracheomalacia, should be identified and treated.

Comment: The difficult decision for general pediatricians is when to refer a child who is suspected of having laryngomalacia for direct visualization of the airway. If the clinical picture is atypical or if the stridor is accompanied by poor feeding, failure to gain weight, or episodes of cyanosis, apnea, or hoarseness, the child certainly deserves further evaluation. However, what about the typical baby, who is feeding well and gaining weight and whose stridor began in the first month or two after birth, is intermittent and mild, and is better when the child is prone and perhaps worse when the child has an upper respiratory tract infection? In one review, only 4% of more than 200 children evaluated for laryngomalacia had a significant complicating lesion detected by endoscopy, and they all had either unusual histories or uncharacteristic stridor on physical examination. Clinical judgment still has its place.

Henry M. Adam, MD
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Figure 3. Bronchoscopic findings in tracheomalacia. During inspiration, the trachea remains patent and the carina is easily visible. During expiration, the trachea collapses on itself, obstructing the carina and distal airways.
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