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Review

Assessment and causes of stridor

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EDUCATIONAL AIMS

After reading this review readers will be able to:

- Understand the importance of medical history and physical examination in a child with stridor from birth to adolescence
- Discuss congenital and acquired causes of stridor according to the site of obstruction within different age groups
- Describe the principles of airway endoscopy, radiology and lung function in the assessment of stridor

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SUMMARY

Stridor is a variably pitched respiratory sound, caused by abnormal air passage during breathing and often is the most prominent sign of upper airway obstruction. It is usually heard on inspiration (typically resulting from supraglottic or glottic obstruction) but also can occur on expiration (originating from obstruction at or below glottic level and/or severe upper airway obstruction). Stridor due to congenital anomalies may exist from birth or may develop within days, weeks or months. Various congenital and acquired disorders prevail in neonates, infants, children, and adolescents, and have to be distinguished. History, age of the child and physical examination together often allow a presumptive diagnosis. Further investigations may be necessary to establish a definite diagnosis, and flexible airway endoscopy is the diagnostic procedure of choice in most circumstances (“stridor is visible”).

INTRODUCTION

Stridor, a variably high pitched respiratory sound, often is the most prominent sign of upper airway obstruction (UAO). It is usually heard on inspiration but it also can occur on expiration in severe UAO, and indicates substantial narrowing of the larynx and/or (extrathoracic) trachea. In minor degrees of narrowing there may be no stridor at rest; with increased activity (e.g. crying) and consequently increased velocity of airflow, however, stridor may develop. Biphasic stridor suggests severe, fixed airway obstruction at the level of the glottis, subglottis, or upper trachea. Loud stridor, especially when associated with retractions, occurs with significant narrowing of the airway; however, a sudden decrease in volume sometimes signifies worsening obstruction and decreasing air movement.

The character of the voice provides additional important information. Hoarseness suggests an abnormality of the vocal cords. A muffled voice with a low-pitched stridor may indicate a supraglottic process such as epiglottitis (supraglottitis).

Stertor, another form of noisy breathing, is a mainly inspiratory, low pitched, wet, grunting sound similar to snoring. Obstructing lesions of the nasopharynx (such as adenoid hypertrophy), oropharynx (such as micrognathia, macroglossia, and tonsil hypertrophy), and hypopharynx (such as tongue base mass and pharyngomalacia) typically produce stertor [1,2].

Stridor due to congenital pathologies may exist from birth or may develop within days, weeks or months after birth. Different congenital or acquired disorders prevail in different age groups (neonates, infants, children, adolescents) and have to be distinguished. Taking a careful history is mandatory. History, age of the child and physical examination together often allow a presumptive diagnosis. Further investigations may be necessary to establish a

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definite diagnosis, and flexible airway endoscopy is the diagnostic procedure of choice in most circumstances [3,4].

HISTORY AND PHYSICAL EXAMINATION

The age of the patient and the onset and duration of symptoms are the most important items for narrowing the differential diagnosis. The perinatal history is important and should include questioning regarding maternal condylomata, type of delivery (including shoulder dystocia), endotracheal intubation and its duration, and presence of congenital anomalies. A surgical history should be obtained; previous surgery, particularly neck or cardiothoracic procedures, puts the recurrent laryngeal nerve at risk for injury. Furthermore, a developmental history should be obtained.

Feeding and growth should be evaluated as significant airway obstruction can lead to increased "work of breathing" causing a "caloric wasting", resulting in a lack of weight gain and poor growth. Regurgitation and possetting could be signs of gastro-esophageal reflux (GER), which can cause laryngeal and tracheal mucosal irritation with subsequent oedema. The occurrence of cyanosis, and/or apnoea and increased respiratory effort have to be explored. Information about the circumstances (e.g. supine positioning, feeding, crying, sleep) in which stridor occurs, improves or deteriorates, may help to localize the obstruction. The most common symptoms and signs related to feeding include regurgitation, vomiting, cough, and choking.

During inspection and auscultation attention should be paid to retractions (suprasternal, intercostal, subcostal), nasal flaring, cyanosis, the patient's preferred body position, and possible syndromal deformities (especially craniofacial anomalies). Dysphagia and drooling may be associated. The skin should be assessed for haemangiomas. Assessment of the type of stridor (inspiratory, expiratory, biphasic) may provide information about severity and level of airway obstruction. Further information may be derived from the pitch and the character of the stridor, either voiced (a pure tone and overtones) or fricative (a noise like sound). A typical laryngeal stridor is inspiratory, high pitched and voiced, whereas a pharyngeal obstruction causes a bidirectional, low pitched and fricative sound. However, localization of stridor is poor with clinical observation [5].

AIRWAY ENDOSCOPY

Flexible endoscopy allows one to examine the airways from the nose to the segmental bronchi. The investigation should be performed under light (or even without) anaesthesia to optimally visualize dynamic airway caliber changes. If during examination there is no respiratory noise and no airway pathology can be visualized, the level of anaesthesia should be altered so that airway obstruction will occur and can be documented. In children with stridor predominantly during sleep polysomnography may have already shown obstructive sleep apnoea (OSA). In this situation, so called sleep endoscopy may be the investigation of choice as it allows airway evaluation in a sleep-like state. [6] With flexible endoscopy the site and extent of airway obstruction and a possible cascade of various levels of obstruction can be documented. Flexible endoscopy is a very useful tool for diagnosing choanal pathologies and adenoid hyperplasia, and helps to estimate which anatomical structures participate in a pharyngeal and/or laryngeal collapse. A thorough inspection of the tongue base, supraglottis, glottis and subglottis followed by an inspection of the trachea and bronchi to gain information on possible associated airway pathologies in the lower airways is advisible in most circumstances. Exceptions from this rule are substantial subglottic stenosis from e.g. haemangiomas where the passage of the bronchoscope would possibly aggravate airway obstruction. Direct airway examination is indicated in virtually all infants with persistent stridor, especially when stridor is progressive or associated with cyanosis, apnoeas, difficulty in feeding, or failure to thrive. Documentation of laryngomalacia and the exclusion of other causes of stridor in an infant usually alleviates parental anxiety and may prevent further (unnecessary and potentially harmful) diagnostic evaluation. In infants and children with viral croup, endoscopy is rarely indicated unless there is no response to treatment or stridor persists for longer than two weeks [7].

A rigid endoscope approaches the larynx from a different angle; it elevates the hyoid and tongue base, lifting and distorting the larynx, while at the same time allowing a more detailed anatomic evaluation especially of the posterior aspects of larynx and trachea, as well as manipulation. When posterior laryngeal pathology (e.g. laryngeal cleft) is suspected, both flexible and rigid instruments may be needed to obtain a full understanding of the laryngeal anatomy and dynamics [8].

RADIOLOGY

Plain radiographs have a role in assessing the lungs and cardiac size, and may help to exclude a radiopaque foreign body. A normal frontal and lateral chest radiograph has been shown to exclude a vascular ring. The radiograph may show a right sided aortic arch, a poorly visualised distal trachea, or another cause for tracheal compression or deviation (e.g. a mediastinal mass) [9]. Fluoroscopy has lost importance because of the considerable amount of radiation even in short investigations and the availability of new imaging modalities. Upper gastrointestinal contrast studies may be helpful in diagnosing aspiration and be suggestive in conditions such as an H-type tracheo-oesophageal fistula or a posterior laryngeal cleft. A barium swallow remains an excellent technique for the diagnosis of a vascular ring, but the exact anatomy of a vascular malformation and its relation to adjacent structures has to be accurately defined by magnetic resonance imaging (MRI) and/or low dose multidetector computed tomography (MDCT). The latter techniques are most useful in confirming extrinsic compression of the airways (e.g. retropharyngeal soft tissue swelling), and provide information about the extent of masses such as haemangiomas in the surrounding soft tissue. Furthermore, virtual endoscopy by CT may be used in assessing fixed stenoses that cannot be passed during endoscopy. Ultrasonography may be of value in parapharyngeal and peritonsillar abscesses as well as lymphadenitis causing compression of laryngeal structures. Furthermore, laryngeal ultrasonography, although not seen as a substitute for flexible endoscopy, can give valuable information for differentiating cystic from solid masses and in the assessment of the vocal cords [7,10,11].

LUNG FUNCTION TESTING

Lung function testing can only be used in patients with minor UAO, because the measurement itself may disturb the patient and lead to deterioration. In infants and young children with persistent stridor, tidal breathing flow-volume loop analysis may be used as a first diagnostic approach, that may add useful information to physical examination. In these patients, it has been shown to be a rapid, non-invasive and accurate method for establishing the site of airway obstruction [7,12]. Visual inspection of maximal inspiratory and expiratory flow-volume loops, produced by patients able to co-operate, allows variable and fixed airway lesions to be distinguished. The flow-volume loop in a patient with variable extrathoracic airway obstruction is characterized by a plateau in the inspiratory limb (e.g. tracheomalacia of the extrathoraxic trachea), and the flow-volume loop in a patient