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Stridor in children

Case report

A 16-month-old boy was referred to the emergency department of the Children's Clinical University Hospital (Riga, Latvia) due to cough and noisy breathing for 3 months. The complaints seemed to have worsened over time with coughing fits 2–4 days a week and the boy not being able to tolerate solid food (leading to vomiting) during the fits. In between the bouts, he felt fine. Diminished food intake was noted over the last month. Over the 3-month period, no other symptoms were noted. The father of the child was fixated on a diagnosis of asthma and categorically denied the possibility of any choking attacks after eating or playing with small objects. The boy had been seen by pulmonologist once over the preceding 3-month period and was treated with salbutamol and high-dose fluticasone propionate inhalations that offered no alleviation of the symptoms. No imaging studies had been performed.

On physical examination, the patient was a happy 16-month-old with loud, high-pitch inspiratory stridor heard only when the boy started crying. The patient became uncooperative on examination, which led to agitation and crying, and proper auscultation could not be done.

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Tasks

1. Which test should be performed first?
   a) Direct laryngoscopy
   b) Endoscopy
   c) Chest radiography
   d) Computed tomography
2. What is the most likely diagnosis?
   a) Bronchial asthma
   b) Foreign body inhalation
   c) Congenital disorder
   d) Vocal cord dysfunction

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Several conditions that manifest as stridor can mimic asthma. When there is an initial failure in therapy, other diagnoses should be considered. The absence of witnessed choking does not exclude an inhaled/ingested foreign body. http://ow.ly/bqRD30kJcgI

Answers

1. c.
2. b.

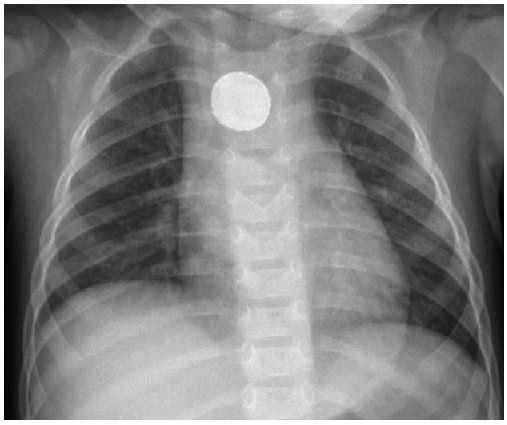

Figure 1 *Chest radiogram of a 16-month-old child with history of stridor for 3 months.*

Chest radiography (figure 1) revealed a round foreign body (2 cm in diameter) at the level of the second oesophageal constriction with no other pathological findings. An immediate endoscopic evaluation, performed under sedation, confirmed the presence of a lithium battery at the level of the second oesophageal constriction with local granulation tissue and a fibrin coating (figure 2). Unfortunately, the initial removal manoeuvres failed as the foreign body slipped out in the nasopharynx; it was evacuated by an ear, nose and throat specialist.

Review of the case performed at 12 and 15 days after the first endoscopy revealed chemical oesophagitis and mild scarring deformation.

Stridor is a high-pitched, monophonic sound caused by partial obstruction of the large airways that results in turbulent airflow in the respiratory passages [1–3]. It is quite common and can be observed in children of various ages. Stridor is usually loud and can be heard without a stethoscope [2] but the volume of stridor does not correlate with the severity of obstruction [3]. It is a symptom not a diagnosis and underlying pathology must be determined as it may be life threatening [3].

The differential diagnosis of stridor is vast with upper respiratory tract infections (croup most commonly), foreign body aspirations (common in childhood) and laryngomalacia (the most frequently seen underlying pathology in case of congenital stridor) [4, 5]. The characteristics of the pathologies and diseases causing stridor are reviewed in table 1.

Undoubtedly, careful history and clinical examination are the primary steps in diagnosing the underlying pathology. The following information should be gathered to differentiate the cause of stridor.

- Prenatal and obstetric history
- Onset of symptoms: acute, chronic or subacute (table 1)
- Age at onset of symptoms
- Associated symptoms (voice change, fever, cough, drooling, rash, wheezing, regurgitation, *etc.*)
- Any known adverse events (operations, intubation, exposure to smoke or hot air, ingesting hot liquids or caustic agents, playing with small objects, choking, *etc.*)
- Association of stridor with body position, feeding, stress, *etc.*
- Associated and underlying disorders (genetic diseases, oesophageal atresia, *etc.*)
- Vaccination history, particularly *Haemophilus influenzae* type b
- Previously performed investigations and therapy

Stress, crying and agitation (separation from parents, blood tests, examination of the throat, *etc.*) should be limited in a child with acute stridor since they can significantly worsen airway obstruction [3]. The breathing pattern, behaviour and the characteristics of the stridor may act as clues to the level of airway obstruction. In general, inspiratory stridor originates from obstruction in the extrathoracic region above the vocal cords (*e.g.* croup or epiglottitis); expiratory stridor, in the intrathoracic region (*e.g.* tracheomalacia, bronchomalacia or airway compression); and biphasic stridor is caused by fixed central airway obstruction at or below the cords (*e.g.* bilateral vocal cord paralysis, laryngeal web, haemangioma or subglottic stenosis) [1–3]. If epiglottitis is strongly suspected, cautious examination is warranted in order to avoid anxiety, respiratory effort and imminent functional airway obstruction [5, 29].

Often, the diagnosis can be made clinically and additional investigations are not always necessary.

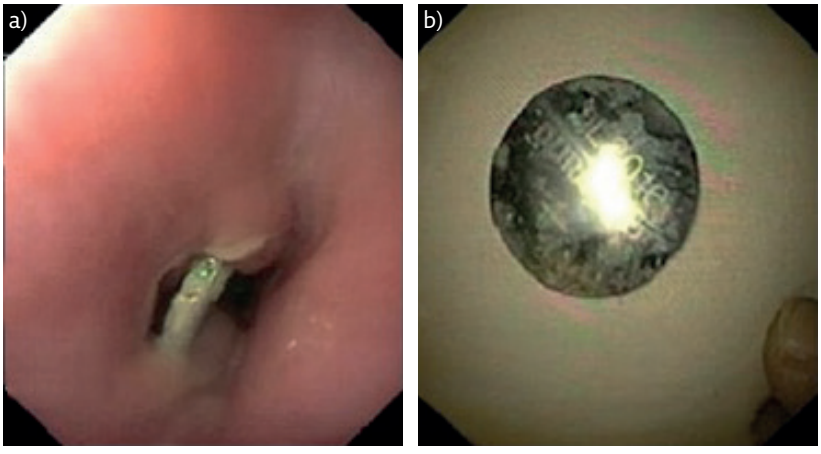

Figure 2 *Endoscopic evaluation of oesophagus in a 16-month-old child with history of stridor for 3 months. a) Foreign body at the level of the second oesophageal constriction. b) Foreign body (lithium battery) after removal from the oesophagus.*

Table 1 *Characteristics and additional diagnostic techniques to differentiate the causes of stridor in children*

	Characteristics	Additional diagnostic techniques
Acute		
Foreign body aspiration or ingestion [5–7]	Peak age 1–3 years Sudden-onset coughing and choking that might be followed by symptom-free period, and thus be misinterpreted as resolution Potentially life threatening	Chest radiography CT when suspected that negative result might avert bronchoscopy Bronchoscopy
Anaphylaxis	Potentially life threatening Possible additional symptoms (skin and/or gastrointestinal)	Detail history of the episode
Infection		
Bacterial tracheitis [7]	Any age; most commonly, first 6 years ARVI-like prodromal period Croup-like symptoms that do not respond to standard croup therapy	Direct laryngoscopy and/or bronchoscopy gives a definitive diagnosis but is not routinely performed Specimens for aetiological diagnosis during endoscopy immediately after intubation; older patients might provide sputum
Epiglottitis [7]	Decreased incidence and increased age at presentation (previously 3 years, now 6–12 years) since Hib vaccine was introduced Sudden onset, rapid progression Hallmark: three D's (dysphagia, drooling and distress), fever, toxic appearance, hoarse voice, stridor, pharyngitis Various degrees of severity Young children: respiratory distress, anxiety, "tripod"/ "sniffing" posture, drooling; cough not characteristic Older children: might just have severely sore throat	Often clinical diagnosis Direct laryngoscopy (swollen epiglottitis) Lateral radiography of the neck, looking for the "thumb sign" Laboratory tests and microbiology only if the airways are safe Need for a very cautious examination is warranted in theatre with experienced anaesthetist and an ENT specialist capable of performing an emergency airway procedure
Diphtheria [7]	Presenting symptoms: malaise, sore throat, fever (low grade), cervical lymphadenopathy Mild pharyngeal erythema → isolated exudate (grey, white) → pseudomembrane (at least one third of cases); pseudomembrane can extend to lower parts of respiratory system Laryngeal diphtheria (pseudomembrane covers larynx) might be isolated (cough, hoarseness) or a part of malignant diphtheria (stridor, respiratory insufficiency) Systemic manifestations: myocarditis, neuropathies	Culture of *Corynebacterium diphtheriae* from respiratory tract Toxin detection Laryngoscopy: pseudomembrane
Airway burns		
Thermal epiglottitis and upper airway burns [8]	Clinical presentation similar to that of infectious epiglottitis; might not correlate with severity, especially in younger children With/without cutaneous burn injury Risk of rapid airway obstruction (because of developing oedema)	Direct laryngoscopy Bronchoscopy

(*Continued*)

Table 1 *continued*

	Characteristics	Additional diagnostic techniques
Caustic burns [9]	More common 1–3 years of age Upper airway involvement: hoarseness, stridor, nasal flaring, retractions Other symptoms: food refusal, drooling, dysphagia (oropharyngeal/ oesophageal injury) Symptoms might not correlate with severity, especially in younger children May be misdiagnosed as anaphylaxis	Direct laryngoscopy Bronchoscopy
Subacute		
Retropharyngeal abscess [7, 10, 11]	Peaks at 2–4 years of age Often after upper airway infection (tonsillitis, pharyngitis, lymphadenitis) Early stage: symptoms indistinguishable from uncomplicated pharyngitis Later stage: dysphagia, odynophagia, drooling, torticollis, neck pain, dysphonia, respiratory distress, stridor, trismus, fever, chest pain Symptoms might be similar to that of epiglottitis but progress slower	Lateral neck radiograph (might be false positive if the child is crying) CT scan with intravenous contrast
Peritonsillar abscess [7, 12]	More often in adolescents Severe sore throat (mainly unilateral), fever, muffled voice, trismus, drooling	Pus drainage from abscess confirms diagnosis Laboratory tests not necessary Imaging studies not routinely performed; might help differentiate peritonsillar abscess from cellulitis (intraoral or submandibular US), deep space neck infection (CT scan with contrast) and epiglottitis (direct laryngoscopy, lateral neck radiograph)
Chronic/recurrent		
Congenital		
Laryngomalacia [5, 7, 13]	Usually begins at neonatal period: 4–5 weeks, peaks at 4–8 months; may resolve by 12–18 months Inspiratory "wet" low-pitch stridor; hoarseness is atypical May worsen in the supine and improve in the prone position Worsens during respiratory infections Mild to moderate: louder when sleeping and feeding; may disappear when crying Severe: louder when crying. Severe: associated with other problems (sleep disordered breathing, failure to thrive *etc.*) Higher incidence of gastro-oesophageal reflux	Flexible laryngoscopy if associated problems are noted (failure to thrive, apnoea, significant/progressive stridor, *etc.*) Sleep endoscopy: suspicion of state dependent laryngomalacia (during sleep)
Tracheomalacia [5, 14, 15]	Usually manifests from 2–3 months of age More common in children with oesophageal atresia Barking or brassy cough, stridor Moderate: more frequent lower airway infections Severe: upper respiratory tract obstruction, cyanosis, apnoeic spells Symptoms might become more evident with activities (crying, eating)	Dynamic airway endoscopy: diagnostic tool of choice CT scan: end-expiratory and end-inspiratory images (endotracheal intubation needed in young kids) Free-breathing cine CT scan (can be used in young children, does not require breathing manoeuvres cooperation) Barium oesophagography (evaluating tracheal compression by oesophagus or other structures)

(*Continued*)

Table 1 *continued*

	Characteristics	Additional diagnostic techniques
Vocal cord paralysis [5, 7, 16]	Onset of symptoms: birth to 5 years Bilateral (birth trauma, neurological, unknown reason): stridor, respiratory insufficiency, cyanosis	Flexible fibreoptic nasopharyngolaryngoscopy Direct laryngoscopy Laryngeal ultrasound
Vascular ring [17]	Great clinical variability from critical airway obstruction to asymptomatic (incomplete vascular ring) Stridor (usually louder during expiration), wheezing, cough, respiratory distress, respiratory infections Digestive system complaints: dysphagia, feeding difficulty, vomiting (complete vascular ring) Associated anomalies: congenital heart disease, tracheo-oesophageal fistula, cleft lip/palate, subglottic stenosis, genetic or malformation syndromes	Anterior, posterior, lateral chest radiograph (compressed trachea, anterior bowing of the trachea) CT scan or MRA Echocardiography Bronchoscopy (not routinely performed) Barium swallow (not routinely performed)
Bronchogenic cyst [14]	Usually presents in adolescence with recurrent cough, wheezing (might simulate asthma), pneumonia Starting in infancy: respiratory distress, cyanosis, feeding difficulty	Chest radiograph CT scan, MRI
Laryngeal malformations [13]	Cyst (vallecular, saccular), laryngocele, stenosis, cleft usually present in infancy/early childhood Stridor, wheezing, noisy breathing, hoarseness, aspiration, recurrent respiratory infections, feeding difficulty, failure to thrive	Endoscopy
Infantile haemangiomas [5, 7, 13, 18]	Symptoms typically start at 1–3 months and resolve by 5–12 years of age Presentation similar to that of subglottic stenosis; recurrent croup, biphasic stridor (may progress to respiratory distress) Initially might be misdiagnosed as croup; response to standard croup therapy is transient Might be associated with other haemangiomas, especially in the "beard" distribution	Endoscopy Radiograph of the neck: asymmetric narrowing of the subglottis CT scan with contrast: delineating
Subglottic stenosis [5, 7, 13, 19]	Biphasic stridor, recurrent episodes of croup and barking cough Typically improves with time	Endoscopy
Acquired		
VCD or paradoxical vocal fold motion [20, 21]	Transient improper adduction of the true vocal folds (inspiration and/or expiration) Great clinical variability; may also mimic other diseases (*e.g.* asthma attack), frequently misdiagnosed Various triggers: exercise, stress, irritants, infections, *etc.* Stridor, globus sensation, difficulty swallowing, chest tightness, aphonia/dysphonia, sensation of choking that can lead to stress, anxiety, panic Usually self limiting	VCDQ (symptom monitoring) Pittsburgh VCD index (differential diagnosis with asthma) Direct flexible laryngoscopy (if possible, after bronchoprovocation challenge) is the gold standard Pulmonary function testing (possible changes in inspiratory loop) Impulse oscillometry

(*Continued*)

Table 1 *continued*

	Characteristics	Additional diagnostic techniques
Recurrent respiratory papillomatosis [22, 23]	Juvenile (usually more aggressive; most commonly 2–4 years of age) or adult (diagnosis after 12 years of age) onset Hoarseness: usually the presenting symptom, followed by stridor. Less often: failure to thrive, chronic cough, dysphagia, dyspnoea, acute respiratory distress, recurrent pneumonia. Often misdiagnosed as croup, asthma, allergies, bronchitis, vocal nodules. The diagnosis usually made 1 year after the onset of symptoms	Laryngoscopy
Vocal cord paralysis	Unilateral (usually iatrogenic): hoarse voice, crying affections; risk for aspiration	Flexible fibreoptic nasopharyngolaryngoscopy Direct laryngoscopy Laryngeal ultrasound
Subglottic stenosis [24]	Symptoms similar but less severe to that of congenital subglottic stenosis	Endoscopy
Hypocalcaemic laryngeal spasm [25]	Children with vitamin D deficiency and rickets (mostly); metabolic/endocrine disorders that result in hypocalcaemia Stridor: chronic intermittent or acute and severe; rarely as presenting symptom Other symptoms due to hypocalcaemia: muscle contractions, anticonvulsant-resistant seizures; in neonates: apnoea, lethargy, poor feeding, abdominal distension, tachycardia, vomiting	Chvostek or Trousseau sign Blood tests: electrolytes, alkaline phosphatase, phosphate, magnesium, PTH, vitamin D metabolites, liver function tests ECG: prolonged QTc Urine tests: pH, calcium, magnesium, phosphate, creatinine Urine calcium/creatinine ratio
Tumour [26]	Tumors that compress the airways may present with expiratory stridor, shortness of breath, cough, hoarse voice	Chest radiograph: mediastinal masses are commonly discovered on routine test
GORD [27, 28]	Nocturnal stridor and cough are atypical manifestations of GORD Other symptoms Infants: feeding refusal, poor weight gain, haematemesis, anaemia, respiratory symptoms Preschool: intermittent regurgitation, respiratory symptoms, decreased food intake and poor weight gain; Sandifer syndrome School-aged children and adolescents: postprandial cough, chronic cough, hoarseness, dysphagia, globus sensation, bitter taste in mouth, heartburn, nausea	Empiric treatment 24-h pH monitoring or impedance monitoring Endoscopy and histology

CT: computed tomography; ARVI: acute respiratory viral infection; Hib: *Haemophilus influenzae* type b; ENT: ear, nose and throat; US: ultrasonography; MRA: magnetic resonance angiography; MRI: magnetic resonance imaging; VCD: vocal cord dysfunction; VCDQ: Vocal Cord Dysfunction Questionnaire; PTH: parathyroid hormone; QTc: QT interval; GORD: gastro-oesophageal reflux disease.

Conflict of interest

None declared.

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