Functional Symptoms in Pulmonology: Taking Your Breath Away

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Abstract

Children with respiratory symptoms often are affected by a functional contribution to their presentation. In order to provide appropriate comprehensive care, clinicians need to identify and address these issues in such children. Some respiratory diagnoses are recognized generally to be of functional origin including functional dyspnea, habit cough, and vocal cord dysfunction. The criteria for establishing these diagnoses are discussed in the first section of this chapter. However, commonly unrecognized are the children with diagnosed physiologic disease such as asthma, bronchopulmonary dysplasia, or cystic fibrosis who develop additional or worsening symptoms due to emotional or psychosocial overlay. Whether triggered by physiological or psychological factors, symptoms may be identical, and thus clinicians may even be unaware of the psychological impact on a patient. The second section of this chapter will address how clinicians might recognize and offer optimal treatment for such patients.

Keywords

Anxiety • Asthma • Dyspnea • Habit cough • Vocal cord dysfunction

Children who present with respiratory symptoms often are affected by a functional contribution to their presentation. In order to provide appropriate comprehensive care, clinicians need to identify and address these issues when they exist [1].

Some clinicians will readily recognize the functional origin of certain respiratory diagnoses including functional dyspnea, habit cough, and vocal cord dysfunction (VCD). The criteria for establishing these diagnoses are discussed in the first section of this chapter.

However, less commonly recognized are children with diagnosed physiologic disease such as asthma, bronchopulmonary dysplasia, or cystic fibrosis (CF) who concurrently develop symptoms arising as a result of emotional or psychological issues. Sometimes, these symptoms are identical irrespective of their origin and clinicians may

The online version of this chapter (doi:10.1007/978-1-4899-8074-8_4) contains supplementary material, which is available to authorized users.

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R.D. Anbar (ed.), *Functional Symptoms in Pediatric Disease: A Clinical Guide*,
DOI 10.1007/978-1-4899-8074-8_4, © Springer Science+Business Media New York 2014

even be unaware of the psychological impact the physical illness and its consequences has on a patient. The second section of this chapter addresses how clinicians might recognize and offer optimal treatment for such patients.

Commonly Recognized Functional Respiratory Disorders

Functional Dyspnea

Clinical Presentation

Dyspnea can be defined as difficult or labored breathing or shortness of breath. It can occur in the course of normal exercise, in the context of cardiopulmonary disease, and/or because of a psychological reaction. Functional dyspnea can present with rapid or noisy breathing, or may solely be evident to the patient [2]. Clinical examples of functional dyspnea include hyperventilation, sighing dyspnea, and VCD (discussed below) [3].

Patients with functional dyspnea frequently report that they feel as though they cannot inhale fully or catch their breath. When exercise is a trigger of functional dyspnea, patients report development of symptoms much earlier during exertion than would be expected based on their level of conditioning [2]. Dyspnea resulting from hyperventilation often is associated with symptoms of hypocarbia including dizziness, chest wall pain from muscle spasm, and tingling or numbness of their extremities (paresthesia). Patients with panic disorder frequently report an intense fear of dying when they first develop associated dyspneic episodes [2].

In the absence of a concurrent medical illness, the physical examination of most patients with functional dyspnea is normal, with the exception of rapid and deep breathing during an acute hyperventilation episode. Spirometric testing at rest also is normal. Exercise pulmonary function testing can help establish whether the dyspnea is related to an underlying physiologic abnormality or normal physiologic limitation [4]. Hyperventilation provocation tests with concurrent measurements of end-tidal carbon dioxide have been utilized to diagnose patients with hyperventilation. In comparison to unaffected individuals, patients who hyperventilate demonstrate lower levels of carbon dioxide at rest, and a slower recovery of their carbon dioxide level following voluntary overbreathing [5].

Natural History

Functional dyspnea is well known to be related to psychological issues. Patients with hyperventilation frequently have been diagnosed with anxiety, panic, conversion disorder, and phobic symptoms [6, 7]. Further, the majority of patients with generalized anxiety and panic disorders develop hyperventilation [8].

Differential Diagnosis

As dyspnea often is the result of cardiopulmonary disease, clinicians must be cautious in making a diagnosis of functional dyspnea and consider a large differential diagnosis [2]. For example, dyspnea can occur as a result of an upper airway obstruction such as from a foreign body, angioedema, or an infectious process. Common lower airway disease that causes dyspnea includes asthma, laryngotracheobronchitis (croup), and pneumonia. Cardiac causes include arrhythmias and congestive heart failure. Other diagnoses to consider include anemia, metabolic alkalosis, and toxigenic causes such as carbon monoxide poisoning, or salicylate overdose [2]. An appropriate workup for dyspnea that is negative can serve as the basis for reassurance as therapy.

Functional dyspnea typically resolves within minutes without specific therapy, in contrast to dyspnea that is the result of cardiopulmonary or metabolic disease [2].

Treatment

Functional dyspnea can improve with reassurance [7], acupuncture ([9], Chap. 23), biofeedback ([10], Chap. 20), breathing techniques [11, 12], cognitive behavioral therapy (Chap. 19), and hypnosis ([13], Chap. 21).

Habit Cough

Clinical Presentation

Children with habit cough typically present with a loud, disruptive cough that has been described

as "honking," "brassy," or "barking." The cough often increases when patients pay attention to it, usually improves when children are distracted (e.g., while playing a videogame), and ceases when they are asleep. Notably, during the process of falling asleep habit cough sometimes intensifies [14–16]. (Video 4.1 shows a patient with habit cough, who is receiving treatment with self-hypnosis.)

Atypical forms of habit cough include children in whom the cough is not disruptive and who manifest some coughing while they are asleep [14].

The physical examination of children with habit cough usually reveals no abnormalities [16]. Pulmonary function testing of children with habit cough is normal [14, 16], although if the cough has been triggered in association with another pulmonary disease such as asthma, the testing may reflect abnormalities associated with the other disease. Other diagnostic testing often is unnecessary in a child with classic habit cough, when the diagnosis can be made based on the characteristic clinical presentation. Chest radiography studies are normal [16]. Bronchoscopy usually is normal, although sometimes patients develop tracheal petechiae as a result of their intense coughing, which should not be confused as a primary trigger of the cough [1]. In other patients, localized tracheomalacia has been identified occasionally, which was thought to have been preexisting in patients who later developed a habit-like cough [17].

Natural History

Habit cough often is triggered by upper respiratory infections, but persists once the infection resolves. It also has been reported to be triggered by asthma [14].

In one case series, half of children with habit cough missed at least a week of school as a result of the disruptive nature of their symptom [14].

Without therapy, habit cough has been reported sometimes to persist for years [18].

Differential Diagnosis

The differential diagnosis for habit cough includes asthma, protracted bacterial bronchitis, pertussis (whooping cough), and tracheomalacia [16]. While habit cough tends to cease when patients are asleep, cough attributable to asthma, bronchitis, and pertussis typically persists during sleep. Tracheomalacia can cause a loud, disruptive cough, which can mimic the type of cough heard in patients with habit cough. However, the cough associated with tracheomalacia often occurs while patients are asleep and does not typically change in frequency when patients are distracted as does habit cough [16].

Treatment

Effective therapy for habit cough includes psychotherapy (see Chap. 19), hypnosis ([14], Chap. 21), and suggestion therapy [15, 16]. During the latter therapy, over a few minute period of time, it is suggested repeatedly to patients that they can control their urge to cough, while they are sipping small amounts of room temperature water or breathing nebulized lidocaine (0.5 ml of 1 % lidocaine diluted to 3 to 5 ml with normal saline).

Vocal Cord Dysfunction

Clinical Presentation

Patients with VCD typically present with complaints of difficulty with inhalation and occasional associated stridor. Frequently, they report a feeling of blockage of their airway at the level of the neck or upper chest [19]. Some patients also develop symptoms suggestive of associated hyperventilation including dizziness, paresthesia, and tremors [2].

VCD frequently is triggered by athletic activity in teenagers and resolves within several minutes of rest. It is less common for VCD to occur during rest [19]. On rare occasions VCD has been reported to persist during sleep [20].

VCD usually occurs as the result of adduction of the vocal cords during inhalation, although on infrequent occasions the adduction occurs during exhalation as well or only during exhalation [19, 21]. Direct visualization of the vocal cords during a VCD episode is diagnostic of this condition. Dynamic 320-slice computerized tomography (CT) also may be helpful in the diagnosis of VCD [22]. Indirect evidence consistent with VCD

includes presence of inspiratory stridor during the physical examination and flattening of the inspiratory flow loops during spirometry [4, 19].

Natural History

VCD often occurs in association with stress. The common type of VCD that is induced by exercise (EIVCD) often occurs in high achieving teenagers (more likely to be female) [23], who are stressing themselves greatly in order to excel. Thus, EIVCD is more likely to occur during athletic competitions rather than practice. VCD has been noted to sometimes occur in association with psychosocial stressors such as parental divorce, academic difficulties, or mental, physical, or sexual abuse of the patient [20, 24].

Differential Diagnosis

Patients with VCD often are first diagnosed as having asthma because of their complaints of shortness of breath. The diagnosis is further complicated by the fact that VCD has been reported to occur concurrently in many patients with asthma (6 % in one series) and exercise induced bronchospasm (31 %) [23]. VCD can be differentiated from bronchospasm given its associated stridor and upper airway obstruction as opposed to the wheezing and lower airway obstruction evident in bronchospasm. Other diagnoses in the differential include exercise-induced laryngomalacia, vocal cord paresis or paralysis, or subglottic stenosis [19]. All of these diagnoses can be excluded based on laryngoscopic evaluation of the upper airway. VCD has been reported to occur in some patients with Chiari I malformation, and this possibility should be considered in very young children with VCD [25], or if patients' symptoms do not resolve with therapy that typically helps resolve VCD (see below).

Treatment

Biofeedback (Chap. 20), breathing techniques [12, 26], hypnosis (Chap. 21), and speech therapy [27] have been utilized successfully in the treatment of VCD. Patients with EIVCD frequently respond to treatment with an inhaled anticholinergic medication that is administered prior to exercise [19, 28] Chap. 26.

When Respiratory Disorders Are Complicated by Functional Symptoms

Clinicians should suspect that a functional component may be affecting the presentation of children with diagnosed respiratory disorders when their symptoms do not improve as expected with standard medical therapy, or if their symptoms cause more distress than typically observed. Further, emotional reactions related to the respiratory symptoms increase the probability of a significant functional component. Table 4.1 lists symptoms that frequently occur in patients with respiratory symptoms that arise as a result of functional issues. It should be noted that emotional issues such as anxiety may be the result of a primary disorder or have arisen in reaction to the medical condition [1].

The medical community often fails to consider functional symptoms as a major cause of respiratory symptoms that fail to respond to standard therapy. Reasons for this include the physician's lack of expertise with recognizing functional complaints and their treatment [28]. Nonetheless, such complaints are very common. For example, in clinical practice at a tertiary care Pediatric Pulmonary Center of 301 consecutive children who were referred for assessment of their respiratory symptoms, 20 % of 6–11-year-olds, and 31 % of 12–18-year-olds were diagnosed as having a functional component that was a primary cause of their presentation [29].

When a functional contribution is suspected, clinicians should reconsider concurrent assessment and management of organic, psychological, and psychosocial issues. Otherwise, patients may end up undergoing unnecessary diagnostic tests and receiving ineffective medications, which can cause further complications. Further, extensive medical testing in response to unresolved symptoms may convince patients that they have a medical condition that the clinician has failed to diagnose. Such a conviction may make patients more resistant to the idea that some of their symptoms are functional in nature [1].

Table 4.1 Symptoms suggestive of functional respiratory disorders

Respiratory symptoms
Chest Pain in the absence of cardiac or gastrointestinal disease
Difficulty with inspiration[a]
Disruptive cough[b]
Dyspnea despite normal lung function[c]
Hyperventilation (which patients may term breathing too fast)
Inspiratory noise (e.g., stridor, gasping, rasping, or squeak)[a]
Localization of breathing problem to the neck or upper chest[a, c]
Sighing[c]
Other symptoms
Anxious appearance
Dizziness[c]
Feeling something is stuck in the throat Lifted shoulders
Palpitations
Paresthesias[c]
Shakiness[c]
Tics[b]
Weakness
Symptom characteristics
Absence during sleep or when patient is distracted
Associated with a particular location or activity
Emotional response to symptoms
Emotional trigger of symptoms
Exposure to traumatic life event
Incomplete response to medications

Adapted from Anbar RD, Geisler SC. Identification of children who may benefit from self-hypnosis at a pediatric pulmonary center. BMC Pediatrics 2005; 5: 6. With permission from BioMed Central Ltd

[a]Suggestive of vocal cord dysfunction

[b]Suggestive of habit cough

[c]Suggestive of functional dyspnea/hyperventilation

There is an extensive literature reporting the association of childhood respiratory disease with psychological issues that can lead to the development of functional symptoms. Additionally, behavioral problems can affect adherence to the prescribed therapeutic regimen for an organic respiratory disorder, and thus be associated with worsening respiratory symptoms [30].

For example, asthma exacerbations are known to occur as a result of stressful life events [31, 32]. Pediatric patients with asthma frequently are found to have clinical anxiety [33, 34]. In turn, anxiety and depression have been shown to be associated with increased asthma symptoms [35]. Patients with CF are at increased risk of developing adjustment problems and internalizing symptoms of depression and anxiety. Thus, children with CF may report physical symptoms associated with psychological difficulties such as abdominal discomfort, muscle tension, shortness of breath, and/or tremors (e.g., as a result of anxiety) [30]. Patients with CF who have developed concurrent attention deficit or oppositional defiant disorders have been reported to be less adherent to their therapies, which has been associated with a poorer prognosis [36]. Patients who were born prematurely and developed bronchopulmonary dysplasia also have been reported to be at increased risk of developing anxiety and attention disorders in later childhood [37, 38], which may affect the nature of their respiratory symptoms.

Treatment

When it is suspected that a respiratory symptom is complicated by a functional problem, patients can be offered an appropriate intervention based upon their developmental age, which is directed at either improving the underlying stressor or teaching the patient how to control their symptoms [1].

For example, if a patient with asthma develops shortness of breath while taking tests at school, the first step is to help the patient understand that his respiratory distress is related to anxiety rather than an asthma exacerbation. To help relieve the anxiety, the patient and his family might be encouraged to discuss the problem with school officials and the patient might be given appropriate coaching and accommodations so that test-taking causes much less stress. Alternatively, the patient might be taught self-regulation strategies to calm himself while taking examinations. Either strategy could help resolve the episodes of shortness of breath.

Interventions that can help improve the underlying stressor include cognitive behavioral therapy (Chap. 19), play therapy (Chap. 28), and reassurance.

Interventions that can help the patient calm himself include meditation (Chap. 24), self-hypnosis (Chap. 21), and yoga (Chap. 25).

Interventions that can help calm the patient but are dependent for the long term on equipment or a healthcare provider include acupuncture (Chap. 23), biofeedback (Chap. 20), and guided imagery (Chap. 22).

There is no evidence in the literature comparing the efficacy of the various aforementioned interventions for functional respiratory disorders. Interventions for individual patients may be chosen based on their availability (e.g., at the office of the primary care provider vs. requiring referral) and patient preference.

For patients whose psychological stress has been caused solely by their reaction to an organic disease, treatment of the underlying pulmonary condition can lead to resolution of the associated functional symptoms [1]. For example, a patient with asthma may become increasingly anxious with associated hyperventilation whenever his asthma is under poor control. When the patient's asthma is brought under control, his anxiety and associated functional symptoms resolve.

Caveats

In some cases, functional respiratory symptoms can cause physical pathology. For example, severe habit cough has been reported to cause airway petechiae or rib fractures, severe VCD has led to loss of consciousness, and hyperventilation has triggered bronchospasm. It is important that clinicians not confuse secondary organic changes in such situations as the primary causes of the patient's presentation [1].

Another common mistake made by clinicians is to assume that abnormalities identified during medical investigations necessarily are the cause of patients' symptoms. For example, a patient with inspiratory stridor as a result of VCD may be found to have an abnormal methacholine challenge test that is diagnostic of asthma. A clinician may thus treat this patient for asthma, even though the abnormal test in actuality was an incidental unrelated finding. When the patient fails to respond to this therapy, the patient erroneously may be characterized as having "difficult" asthma [39].

Some patients develop persistent functional symptoms as a result of a significant psychological disturbance [24]. For example, a patient may develop habit cough in association with depression related to her parents' divorce, or VCD as a result of a conversion disorder related to sexual abuse. Such patients will not respond easily to self-regulation strategies as described above and should be referred for evaluation by a mental health professional (Chap. 18). In rare occasions, patients may benefit from pharmacotherapy for their psychiatric condition such as the use of antidepressants (Chap. 26) [28].

Finally, misdiagnosis of an organic disease as being caused by a functional respiratory symptom can delay appropriate medical treatment. Thus, clinicians should reevaluate their diagnosis of a functional disorder if patients' symptoms fail to improve with therapy that typically helps resolve such conditions [1].

Case Studies

Case 1: Asthma [39]

A 9-year-old boy presented with a long history of recurrent cough and wheezing in association with upper respiratory infections, exercise, change in weather, and exposure to allergens. In later childhood, the child often awoke at night due to cough, even when he was otherwise well. Sometimes, he developed cough and difficulty breathing in association with strong emotions, such as anger or sadness, or when he laughed or cried. His symptoms improved with use of bronchodilator therapy, but use of daily inhaled fluticasone, montelukast, and weekly allergy immunotherapy did not resolve episodic recurrence of his symptoms. As a result, the patient required multiple courses of oral steroids and several hospitalizations for treatment of severe and refractory respiratory exacerbations. He had a history of occasional regurgitation of food, and posttussive emesis. He also suffered from recurrent otitis media and sinusitis until he underwent placement of bilateral tympanostomy

tubes at the age of 4 years, after which he no longer developed otitis. The patient had a history of possible sexual abuse in infancy. His parents divorced when he was a year old. When clinically well, his physical examination was normal. A pulmonary function test revealed a mild obstructive pattern with a significant improvement following bronchodilator administration.

Questions

1. What is the patient's likeliest primary diagnosis?
   (a) Asthma.
   (b) Gastroesophageal reflux.
   (c) Habit cough.
   (d) Immunodeficiency.
   (e) Malingering.
2. All of the following may explain why the patient continued to develop wheezing episodes despite treatment with chronic inhaled corticosteroid or montelukast therapy EXCEPT:
   (a) Lack of adherence to his prescribed therapy.
   (b) His asthma management is complicated by gastroesophageal reflux.
   (c) His asthma management is complicated by emotional triggers.
   (d) Steroid resistance.
   (e) His asthma was severe
3. Given the child's lack of asthma control despite preventive therapy, what is the best next step in this patient's management?
   (a) Review with the patient and his family about the importance of adherence to prescribed therapy.
   (b) Begin therapy with antireflux medications.
   (c) Teach the patient better ways of dealing with his emotions.
   (d) Treat the patient with mometasone rather than fluticasone.
   (e) Start the patient on chronic every-other-day oral methyl prednisolone.

Answers

1. (a): The patient's cough, wheeze, and difficulty breathing in association with upper respiratory infections, exercise, and emotions are characteristic of asthma. That diagnosis is supported by the history of responsiveness to bronchodilator therapy and characteristic pulmonary function test results. While gastroesophageal reflux may complicate the management of asthma [40], it cannot be considered the primary diagnosis given that the triggers of this patient's respiratory symptoms do not typically aggravate gastroesophageal reflux. Patients with habit cough classically do not demonstrate abnormal pulmonary function [16]. As the patient's otitis media episodes resolved once he underwent tympanostomy tube placement and because he has had no other major bacterial infections, it is unlikely he has an immunodeficiency. Malingering is a rare diagnosis and typically is not triggered by infections or exercise [1].
2. (d): As the patient responded to systemic steroid therapy, it is unlikely that he had steroid resistance. Further, it is unusual for a patient with severe and steroid-resistant asthma to have a mild obstructive pattern on pulmonary function testing.
3. (c): This patient had received a number of preventive asthma medications without improvement. Thus, changing the inhaled steroid was unlikely to help. If not previously and repeatedly discussed, review of the importance of adherence could be helpful. Given the severe nature of this patient's asthma, it is likely that the symptoms compatible with gastroesophageal reflux were the result rather than the cause of his uncontrolled asthma. Chronic systemic steroid therapy comes with notable toxicity and should be considered only as a last step when all else fails. When this patient was taught self-hypnosis in order to promote self regulation, calm himself and modulate his emotional responses, his asthma symptoms resolved within a day, thus demonstrating that for him, there was a strong emotional component to his presentation significantly affecting the underlying asthma.

Case 2: Cough [41]

A 12-year-old boy developed an upper respiratory infection with an associated loud, honking cough that persisted during the days for several

weeks, but resolved when he was asleep. He had a history of coughing for up to 2 weeks following upper respiratory infections, which typically he would contract three times a year. He had no history of wheezing or shortness of breath. The boy reported an associated burning in his throat, but no stomachaches, heartburn, regurgitation, or emesis. He has not suffered from recurrent otitis media, sinusitis, bronchitis, or pneumonia. His physical exam and pulmonary function testing results were normal. Use of prednisone, hydrocodone, metoclopramide, omeprazole, and over-the-counter cough suppressants was not of benefit. Because of the disruptive nature of the cough, the patient had missed 50 days of sixth grade and received home tutoring. Nonetheless, he was able to maintain a high grade point average. He said he missed his friends and wanted to return to school.

Questions

1. What is the likeliest diagnosis for this patient's current cough?
   (a) Asthma.
   (b) Gastroesophageal reflux.
   (c) Habit cough.
   (d) Immunodeficiency.
   (e) Malingering associated with school avoidance.
2. Which of the following is an appropriate next step in the management of this patient?
   (a) Reassurance of the patient that the cough is not the result of a medical condition and will resolve on its own.
   (b) Instruction in self-hypnosis utilizing imagery to help the patient relax.
   (c) Provision of suggestion therapy wherein the patient is reassured repeatedly that his cough can be controlled.
   (d) Use of oral benzonatate (Tessalon Perles).
   (e) B or C.
3. If the cough does not resolve immediately after therapy is initiated, should the patient be told that he must return to school no matter how the disruptive the nature of the cough?
   (a) No. The stress of the on-going cough in a social setting would serve to perpetuate it.
   (b) No. It is inappropriate to subject his classmates to the disruptive cough.
   (c) Yes. The patient will feel better when he sees his friends, and this could help resolve his cough.
   (d) Yes. Missing school as a result of habit cough often represents a benefit for patients (i.e., a secondary gain) and thus elimination of the benefit helps promote its resolution.
   (e) A or B.

Answers

1. (c): The patient's cough is characteristic of habit given its loud and disruptive nature, and its absence while he has slept [14]. While his prolonged cough after upper respiratory infections can be consistent with asthma, he does not have other symptoms suggestive of asthma, and he did not improve with use of prednisone that typically resolves an asthma exacerbation. He does not report symptoms suggestive of clinically significant gastroesophageal reflux. He does not report recurrent respiratory infections that would be suggestive of the possibility of an immunodeficiency. Malingering is a rare diagnosis.
2. (e): Either hypnosis or suggestion therapy have been reported to help resolve habit cough [16]. Habit cough can persist for years without intervention, and thus reassurance alone would not be appropriate [18]. Benzonatate is not effective in the treatment of habit cough [16].
3. (d): It is often necessary to arrange appropriate accommodations with the school in order to minimize disruption of the patient's normal routine while avoiding secondary gain derived from being absent from school [1, 14]. For example, the patient should be allowed to spend time at the school nurse's or administrative office, if necessary. Also, school staff should be informed that the cough is not a result of a communicable infection.

Case 3: Dyspnea [42]

An 11-year-old boy presented with a 4-year history of developing shortness of breath while playing soccer. He explained that his dyspnea was associated with difficulty with inhalation, causing

a loud inspiratory noise, and subsequently, a feeling of tightness and burning in the chest, tachycardia, and occasional fear. He denied associated headaches, stomachaches, nausea, or paresthesia. His breathing difficulties kept him from keeping up with his friends. In association with upper respiratory infections, this patient tended to cough for "weeks." He had a history of recurrent bronchitis and pneumonia in early childhood, but not in recent years. He underwent surgery for recurrent sinusitis at 10 years in the hopes that this would reduce his frequency of headaches, which occurred 2–3 times per week. However, his headache frequency did not change following the surgery. His physical examination and pulmonary function testing were normal. His shortness of breath persisted despite trials of several medications for asthma, allergy, and gastroesophageal reflux.

Questions

1. Of the following diagnoses, what is the likeliest cause of this patient's shortness of breath?
   (a) Asthma.
   (b) Gastroesophageal reflux.
   (c) Habit cough.
   (d) Malingering.
   (e) Vocal cord dysfunction.
2. Which of the following tests is likeliest to provide definitive evidence that his patient has VCD?
   (a) Bronchoscopy.
   (b) Chest computerized tomography.
   (c) Laryngoscopy.
   (d) Methacholine challenge test.
   (e) Spirometry.
3. Which of the following is an appropriate therapy for this patient?
   (a) Hypnosis.
   (b) Inhaled ipratropium bromide prior to exercise.
   (c) Speech therapy.
   (d) A and C.
   (e) A, B, and C.

Answers

1. (e): The patient's difficulty with inhalation and loud inspiratory noise (i.e., stridor) is suggestive of an upper airway process. Therefore, asthma is unlikely. While gastroesophageal reflux may lead to upper airway irritation, typically it is not associated with the development of tachycardia or fear. A diagnosis of VCD would be consistent with this patient's upper airway symptoms. His associated anxiety symptoms could be the result of the same psychological stress or that triggered his VCD. Cough is not a prominent part of this patient's presentation, and thus habit cough is not likely. Malingering is a rare diagnosis.
2. (c): In order to diagnose VCD, symptoms must be present. While upper airway laryngoscopy in the presence of dyspnea could demonstrate vocal cord adduction consistent with VCD [19], the anesthesia or sedation required for bronchoscopy would tend to resolve vocal cord findings, and thus prevent the clinician from establishing the diagnosis. A chest CT scan would not demonstrate vocal cord adduction. A methacholine challenge would demonstrate if a patient has hyperreactive airways, a finding not diagnostic of VCD. Finally, if the patient is symptomatic, spirometry might demonstrate blunting of the upper airway flows, consistent with nonspecific upper airway obstruction, which can be attributable to a number of different diagnoses.
3. (e): All of these therapies can be effective for the treatment of exercise induced VCD. VCD that occurs without being triggered by exercise does not improve with use of ipratropium bromide.

Conclusions

Given the high prevalence of functional symptoms, clinicians should consider the possibility of such symptoms in every child who presents with respiratory complaints. When a functional contribution is suspected, clinicians should consider concurrent assessment and management of organic, psychological, and psychosocial issues. Otherwise, patients may end up undergoing unnecessary diagnostic tests and receiving ineffective medications, which can cause further complications.

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