

Review Article

Functional symptoms confused with allergic disorders in children and adolescents

Niggemann B. Functional symptoms confused with allergic disorders in children and adolescents.

Pediatr Allergy Immunol 2002; 13: 312–318. © 2002 Blackwell Munksgaard

The diagnosis of a functional respiratory disorder is sometimes difficult and time-consuming, because the symptoms often resemble those of organic diseases. The most common entities are hyperventilation syndrome, psychogenic cough, sighing dyspnea, and vocal cord dysfunction. Typical signs are heavy breathing or dyspnea, cough or sneezing, various breathing sounds, tightness of the throat or chest, pain, and fear. Criteria for differentiation include the lack of nocturnal symptoms, the sudden occurrence, no typical trigger factors, the variable duration, a quick regression, and that symptoms do not respond to adequate pharmacotherapy and finally normal results of diagnostic work-up.

Therapeutic options comprise psychological intervention (by reassurance, relaxation techniques, and behaviour therapy) and physiotherapy (e.g. breathing therapy, voice training). Intensive efforts should be made to diagnose functional symptoms at an early stage because this will prevent stigmatization and fixation of symptoms and disease, and also prevent children from undergoing unnecessary and potentially harmful therapies.

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Key words: allergy; children;
functional symptoms; hyperventilation;
vocal cord dysfunction

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Accepted 21 January 2002

Abnormal breathing patterns may cause characteristic symptoms and impair quality of life, as has been reported for adults (1). Twenty-nine per cent of adult asthma patients in primary care had symptoms suggestive of dysfunctional breathing (1). For children and adolescents, there are also hints that functional respiratory disorders contribute considerably to morbidity and can frustrate the efforts of physicians (2).

Typical clinical signs accompanying functional respiratory disorders in children are:

- heavy breathing or dyspnea,
- cough and sneezing,
- various breathing sounds,
- tightness of the throat or chest,
- pain, and
- fear.

The diagnosis of a functional respiratory disorder is sometimes difficult and time-consuming, because the symptoms often resemble those of organic diseases (such as bronchial asthma) and there is no single, standardized test of proof. It is therefore probably underdiagnosed, with the consequence of unjustified and potentially harmful therapeutic measures being given.

Furthermore, there seems to be a high rate of chronicity if underlying disturbances are not diagnosed and treated early on (3). The purpose of this article is to raise the awareness of practising pediatricians for some functional complaints that may be confused with allergic diseases, in order to avoid stigmatization and persistence of symptoms and their sequelae.

Hyperventilation syndrome (RVS)

Hyperventilation means overbreathing, although this is often not realized by the patients (and physicians) as such (4). The chief complaints mentioned by the patients are 'can't get my breath', 'shortness of breath', or 'breathing too fast' (3). Other complaints are 'dizziness', 'palpitations', 'weakness', or 'numbness of the hands' (3). Patients or their parents speak of 'spells' or 'attacks' (3). Some children present with recurrent headaches (5). Hyperventilation with emotional origins may be the most common cause of hypocapnia and respiratory alkalosis. Classical complications such as tetany are rare (4).

The duration of attacks vary widely, with many children experiencing symptoms for only a few minutes, while in other cases the symptoms last for several hours (3). The age of onset is typically around 13–14 yr of age. Girls are affected twice as often as boys. Anxiety seems to be the main underlying cause, with concerns about sexuality and health most prevalent (3, 6).

A clinical problem is that hyperventilation syndrome and bronchial asthma often coincide (7, 8), which leads to a vicious circle: hyperventilation with coexisting bronchial hyperresponsiveness leads to asthmatic symptoms and asthma symptoms increase anxiety, which may induce hyperventilation (9). Dyspnea during physical exercise may also be attributed solely to exercise-induced hyperventilation – without any evidence of bronchial asthma (10).

While HVS is relatively benign, failure to recognize it may lead to unnecessary medical examinations (5) and patients have often been seen by many specialists who could not find any organic substrate for their disconcerting complaints (8). Indeed, the disease can present many nonspecific symptoms resembling cardiovascular, cerebrovascular, neuromuscular, gastrointestinal and psychiatric disease (8). One should bear in mind that an 'increased' respiratory rate may not be the same as hyperventilation and that infants and children breathe faster than adolescents and adults, probably due to an elevated metabolic rate (11).

Acute symptoms can be treated with a rebreathing bag, which is universally successful in terminating attacks (3). Only in a few cases are sedatives or tranquilizers needed. Otherwise reassurance and education is the basic treatment. Voluntary hyperventilation for a couple of minutes at the suggestion of the physician may be of great assistance in helping the patient to understand the physiological nature of the symptoms (3, 5). The prognosis of HVS in children and adolescents does not seem to be particularly good because it has been reported that up to 40% of patients show persistent symptoms into adulthood (6).

Vocal cord dysfunction (VCD)

There have been several case reports in the literature over recent decades on upper airway obstruction and inspiratory stridor not responding to aggressive treatment (12), sometimes diagnosed as psychogenic or functional upper airway obstruction (13, 14), psychogenic or functional stridor (15–19), or functional laryngeal dyskinesia (20); the majority of these cases

may today be classed as vocal cord dysfunction (VCD).

During normal, quiet breathing, inspiring is accompanied by widening of the glottis, whereas when expiring the vocal chord narrows due to adduction of the vocal cords. In recent years, a number of cases have been reported of a paradoxical function of the vocal cords leading to dyspnea in children and adolescents (21–31) and even in infants (32, 33).

Trigger-factors for eliciting symptoms of VCD are psychological stress, e.g. anxiety over an impending parental divorce, parental-child conflict, or anxiety about parental expectations of scholastic performance (21, 29). Other eliciting factors include physical exercise (24) or hyperventilation.

During an acute episode of VCD there may be severe respiratory distress, tachycardia, and accessory muscle use. Chest auscultation reveals inspiratory and expiratory wheezing, but not necessarily typical stridor. The character of the inspiratory noise caused by pathological adduction of the vocal cords is similar to the wheezing of asthmatic patients, which may be one reason why VCD is often overlooked – even in hospitals (21). The duration of attacks can vary from a few minutes to days.

The following factors should lead to diagnosis of VCD (29): (I) The dyspnea is predominantly inspiratory (in the absence of upper respiratory tract infections); (II) no (or marginal) response to bronchodilatory therapy; (III) variable flattening of the inspiratory limb of the flow-volume curve suggestive of extrathoracic airway narrowing; (IV) respiratory-cycle dependent assessment of the vocal cords during laryngoscopy under local anesthesia; and (V) no deterioration after discontinuation of anti-asthmatic therapy.

VCD has most often been misdiagnosed as bronchial asthma (24, 29, 34), but in some cases there can be a combination of the two (35). In many but not all patients the diagnosis of bronchial asthma could be discarded. By correctly identifying patients with VCD, unnecessary medication, intubation or even tracheostomy can be avoided (35). Whereas acute attacks may be treated by mild sedation under intensive care supervision, a multidisciplinary approach is needed for the long-term (29).

Inspiratory stridor in young infants is most often an organic disorder and is due to an infantile larynx (formerly called laryngomalacia). It is a functional noise due to softness of the cartilage of the larynx and usually resolves within the first year of life. In addition to bronchoscopy, pneumotachography (as a noninvasive method)

may help to relate inspiratory stridor to one of the obstructive airway diseases (36).

Psychogenic cough

Coughs are a very common symptom in childhood, occurring also in apparently healthy children (37). Although coughing serves an important function, its persistence is often a sign of an underlying abnormality (2).

A dry chronic cough is frequently a sign of bronchial hyperresponsiveness, sometimes called 'cough variant asthma'. Typical trigger factors include upper respiratory tract infections, physical exertion, and the pollen season. Nocturnal and/or morning symptoms are common. Cough variant asthma is by far the most common cause of chronic cough presented not only to pediatricians but also to other specialists such as laryngologists (38). An adequate anti-inflammatory therapy is the mainstay of treatment. However, not all coughs and wheezing are due to bronchial hyperresponsiveness or asthma (39).

A cough persisting over months, without an organic origin can be termed 'habit cough', 'psychogenic cough', 'cough tic', or 'involuntary cough'. It has a croupy character produced by a sharp intake of air and followed by a short explosive expiration, resulting in a characteristic barking or honking sound (2, 40, 41). Patients complain of 'something in their throat' or a 'tickle' (2). The cough is more disturbing to parents, friends and teachers than to the patients themselves (40), but can be annoying enough to make classroom learning impossible (42).

Often, coughing starts during an upper respiratory tract infection or bronchitis (40, 41, 43), and the most common time of year for onset of cough is October to January in the northern hemisphere (41, 42), which may result in a delay of the correct diagnosis. However, symptoms persist after the end of the acute illness changing the character. The cough persists for various periods of time, and several months up to years of symptoms are not uncommon (40). Symptoms may worsen on contact with medical professionals and in the presence of other people (2). All patients stop coughing during sleep (40–44). The fact that 'psychogenic' does not mean 'mild' is supported by a case of an 11-year-old girl with rib fractures due to psychogenic coughing (45).

The behavior of pediatric habit cough patients demonstrates many features consistent with conversion disorder (43). Many of these children obtain secondary gain by avoiding school and remaining at home with the family (43). In

addition to school phobia, attention seeking and anxiety were found in children with cough tics (42, 46).

The medical history should consider the delicate question of smoking (40). Asthma may manifest as chronic cough without obvious wheezing, therefore baseline and sometimes provocation lung function testing should be performed (46).

Response to cough suppressants, expectorants or antibiotic medication is at most marginal or missing (40, 46). However, a behavioral management approach seems promising (47). Inhalation of lidocaine was reported to be helpful in an 8-year-old boy with habit cough (48).

Sighing dyspnea

A sigh is a normal physiological response consisting of a slow, deep inspiration that expands the lungs to vital capacity followed by a slow expiration (49). A deep breath is periodically needed to prevent alveolar collapse from the forces of surface tension during periods of shallow breathing (49). Other authors describe a sigh as an audible inspiration and expiration under the influence of some motion (2). These sighing respirations are not associated with an increase in the ventilatory rate (49). Sighing may also be a normal reaction to fatigue or emotions often including a large psychogenic component (49).

In sighing dyspnea, patients complain of shortness of breath associated with 'difficulties getting their breath', or inability in obtaining a 'satisfying breath' or 'full breath' (2, 49). A typical attack often consists of a series of deep sighing inspirations without an acceleration in the respiratory rate (49). Although patients complain of shortness of breath, there is no objective dyspnea. The term dyspnea refers to an undue awareness of breathing or the need to breathe more (49). Nevertheless, an attack may finally result in subjective distress and the use of accessory muscles of inspiration, mimicking bronchial asthma. In severe cases, the patient appears very anxious and may grasp the chest or throat (49).

Physical examination and laboratory findings are normal, and the diagnosis often has to be made on the basis of the history. Diagnosis is easier if the patients, while being examined, sigh deeply and comment that this pattern of breathing resembles that of an acute attack, albeit much less severe (49). In some instances, both sighing dyspnea and bronchial asthma may coexist, creating a more challenging problem. No results

of long-term follow-up studies are available to assess the natural history of this disorder (2).

Miscellaneous

Throat clearing tic

Young infants often impress parents with rattling breathing sounds, arising from secretions in their throat, larynx or trachea. These infants do not seem to feel the need to clear their throat repeatedly or regularly; these symptoms do not represent disease. In older children, clearing the throat may represent an annoying respiratory tic that requires treatment including habit reversal procedures of reinforcement (50, 51). The term 'dyscrinia', sometimes used for an individual disposition to produce increased and sticky bronchial secretions may describe some organic part of the otherwise psychogenic symptomatology.

Vocalizations

Rare clinical entities may also mimic respiratory diseases (such as bronchial asthma) by vocalizations including coughing, grunting, wheezing, and sneezing, as reported for the neurological disorder Tourette's Syndrome (52, 53).

Chest pain

Chest pains occur in children of all ages (54). About 50% of children presenting are less than 12 yr old (55, 56). In these children, the chest pain is more likely to have an organic cause (57), while in adolescents it is more likely to be associated with a psychogenic disturbance (54). Although chest pains are rarely the result of a serious organic pathology, it is an important complaint that is often troublesome to patient and family (54–56). Respiratory problems, such as persistent cough or asthma frequently cause chest pain (58). Psychogenic disturbances account for about 10% of the cases of pediatric chest pain (56). It has been reported that many children with chest pain had experienced a recent stressful situation that paralleled the onset of the chest pain (56, 59, 60). Anxiety may also be expressed as chest pain (54). In contrast to other functional respiratory disorders, chest pain may lead to sleep disturbances (59). It is often a chronic symptom, lasting more than 6 months (60).

There are several organic causes for chest pain, thus diagnostic procedures should be performed especially carefully before labeling chest pain as psychogenic in origin. Some investigators have reported that serious disease is unlikely to

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develop if it is not present at the initial examination (54, 61).

Paroxysmal sneezing

Sneezing is a normal physiologic response directed toward removal of irritants from the nasal mucosa (2). Paroxysmal or intractable sneezing is an entity mentioned by several authors (2, 53, 62–67). However, little is known about the prevalence of paroxysmal sneezing in the community because most of the information is limited to isolated case reports (2). Female adolescents seem to be most often affected (2, 67). Patients present with a history of persistent and recurrent bouts of sneezing (up to 30–100 per min), with each bout often lasting for hours (2). Typically, during these episodes, patients keep their eyes open, which is unusual in a physiologic sneeze reflex (2, 65). They do not appear distressed and are able to converse, eat, and carry on their activities without hindrance (2). Furthermore, symptoms have not been documented during sleep (2, 65, 67). Precipitating stressors are frequently identified, and a history of psychopathology often surfaces (2). The prognosis seems good if appropriate interventions (e.g. psychotherapy) are undertaken (63, 65).

Diagnostic procedure

From a clinical point of view, there are some criteria that may be helpful in differentiating symptoms provoked by functional respiratory disorders or by organic disease, shown in Table 1. If a functional respiratory disorder is suspected, the following baseline diagnostic procedures are usually performed:

- a thorough medical history (including aspects mentioned in Table 1),
- (bodyplethysmographic) full lung function (if the child is old enough),
- chest X-ray, and
- first, diagnostic session with a psychologist.

According to the clinical picture, the suspected diagnosis and the degree of the symptoms,

Table 1. Criteria for differentiation of functional respiratory symptoms in children and adolescents

Usually no nocturnal symptoms
Occur suddenly (even at rest)
No typical triggering factors
Variable duration
May be quickly regressive
Tachypnea (no objective dyspnea)
Do not respond to adequate conventional pharmacotherapy
Normal diagnostic test results (during episodes of symptoms)

extended diagnostic procedures may consist of a blood gas analysis, a non-specific bronchial provocation test (e.g. histamine challenge, cold air provocation), a deep pharyngeal swab after coughing, serologic titers (mainly pertussis), or flexible endoscopy. Rarely, cardiopulmonary exercise testing, paranasal sinus roentgenograms, CT-scan or MRI are necessary. In a case report, authors suggested hypnosis to be valuable in the diagnosis of vocal cord dysfunction (68).

After an extensive examination, teenagers may find it hard to believe that they do not have a life-threatening illness; furthermore, months of diagnostic tests may encourage patients to adopt a 'sick role', leading to increased withdrawal from normal activities (5). The diagnostic procedure should therefore be as short and as intensive as possible.

Therapeutic options

There are a number of therapeutic options that can be offered as soon as functional respiratory disorder has been diagnosed.

Psychological intervention

Reassurance. 'Reassurance' by physicians, family and professionals is the most prominent instrument to reduce or diminish observed respiratory symptoms in the absence of significant organic abnormality. Reassurance measures should include the demonstration of normal diagnostic results to patients and parents. Even lung function test results or video documentation of laryngoscopy or bronchoscopy can and should be shown and explained. Children and adolescents need to be reassured in specific terms relevant to their fears. Often, a few sessions with a trained psychologist can reduce symptomatology by providing 'professional' reassurance.

Relaxation techniques. Autogenic training and other relaxation techniques may positively influence the pathological breathing pattern and slow down the respiratory rate. Relaxation may also diminish the underlying anxiety. In several studies, self-hypnosis has been reported to be helpful in managing children and adolescents with chronic dyspnea who were documented to have normal lung function (69–71) and for VCD (68). Hypnosis has even been shown to attenuate skin reactions to histamine (72).

Behavior therapy. After a first diagnostic session, it can be decided whether a special institution, familiar in dealing with chronic, psychogenic respiratory problems, should be involved. A behavior therapy attempt can further

be tried. Psychotherapy or psychiatric intervention is only rarely necessary.

Physiotherapy

Breathing therapy, voice training, or speech therapy can help afflicted children and adolescents to become aware of their breathing pattern, and to learn to use their breath and vocal cords in an appropriate way. Specially trained and experienced personnel are required for this work.

Pharmacotherapy

A major goal is to avoid or reduce the use of pharmacotherapy, because this usually maintains the need to 'produce' symptoms. This is especially true for the application of oxygen, which should have no place in the treatment of functional respiratory disorders. In contrast to organic dyspnea, in which sedation is usually contraindicated and may only be considered if the subjective fear is greater than objective dyspnea, it may sometimes be useful to interrupt spells of functional or psychogenic dyspnea.

Miscellaneous

Especially in the case of psychogenic cough, parents and others should be instructed to avoid reinforcing the patient's symptoms through attention (70). Some articles report on children with vocal ties who were effectively treated by 'reinforcement' after problems in the application of a simplified habit reversal procedure (51, 73). There is one report in the literature that the use of a Peak Flow Meter may have given a positive feedback in psychogenic cough in an 8-year-old girl (74).

Conclusions

Intensive efforts should be made to diagnose functional symptoms, which may be confused with allergic disorders in children and adolescents at an early stage, because this will:

- reduce or eliminate harm,
- prevent stigmatization and fixation of symptoms and disease,
- allow an untroubled life (including sports), and
- prevent or children from undergoing unnecessary and potentially harmful therapies.

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