Cough in children: when does it matter?

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INTRODUCTION

Cough is a normal mechanism for maintaining lung health but can be a distressing symptom; at times, this can be out of proportion to the seriousness of the cause. The physiology of cough is thoroughly discussed in another article in this mini-symposium. Consideration of the anatomy and physiology of cough can be a useful vehicle for working through the diagnosis of a troublesome cough.1 Recent diagnostic algorithms have been recommended based on this approach and specialised cough clinics have been advocated.2 Unfortunately, these recommendations have a strong adult medicine directive, with little in the way of a helpful approach for children and adolescents.

Cough is a common presenting problem to paediatricians, with up to 10% of school-aged children3 and up to 20% of parents of pre-school children reporting cough as a symptom.4 The difficulty for the clinician is the poor reliability of reported frequency and severity of the cough.5 Normal cough can be misinterpreted as pathological by anxious parents, or, more seriously, cough caused by a process resulting in pulmonary damage can be misinterpreted as not serious. Whatever the presentation, the symptom of cough is often disturbing to the child and/or parents and should not be dismissed. In this sense, cough presenting to a paediatrician or paediatric respiratory physician always matters.

It is important that children and adolescents are seen by paediatricians and paediatric respiratory physicians. The causes of chronic cough in childhood are significantly different from those in adults, and a different approach to diagnosis and management is needed. In most cases cause can be identified or a satisfactory label given. This review will cover the approach to cough in children and cover some specific causes of troublesome cough not discussed elsewhere in this mini-symposium.

A useful paradigm is to consider whether the cough has a specific cause or can be labelled a non-specific cough.7 What matters for the patient is whether the cause of the cough can be determined and effectively treated. What matters for the respiratory paediatrician is whether the cause of the cough will result in damage to the airways or lung. In most cases, the aetiology of the cough can be sorted out with a complete history and physical examination. This is the principal subject of this review. Investigations to confirm the diagnosis should be requested with specific questions in mind. However, non-specific coughs can be just as troublesome to the patient/family as a cough with a specific aetiology. The paediatrician should be comfortable with applying this label so as to minimise unnecessary investigations and confidently reassure the child/parents.

A more detailed discussion of non-specific cough is made in this review.
Some specific troublesome coughs will be discussed in detail in other sections of this mini-symposium (asthma, habit cough, post-nasal drip, suppurative lung disease). This review will offer a clinical approach to cough in childhood, along with a discussion on some specific coughs and non-specific cough that are not covered elsewhere. This should enable the clinician to diagnose the cause of cough in most cases and know when the cough matters.

### THE APPROACH

#### History

The history of the cough will give the most clues as to the likely aetiology and whether the paediatrician should worry.

The first question of interest is the duration of the cough. This rapidly divides the decision-making tree to either acute-onset coughs or intermittent and chronic coughs. Cough lasting more than 3 weeks is often considered to be chronic; however, it is not uncommon for cough following respiratory tract infections to last longer. A more practical approach is to consider chronic cough as one lasting for 8 weeks or longer, with an overlap period of 3–8 weeks.\(^8\)

The age of the child at the onset of the cough can be helpful, particularly cough that began around the time of birth. These suggest a congenital origin and there are a limited number of possibilities [e.g. tracheomalacia, laryngeal cleft, tracheo-oesophageal fistula (TOF)]. Cough that was delayed until a few weeks of age may also give cause for concern. These may also be congenital in origin or reflect another serious underlying pathology. Examples that are of concern include suppurative lung disease, primary pulmonary aspiration, gastro-oesophageal reflux (GOR) or infection with chlamydia trachomatis. Cough that starts after a few months of age has a broader differential.

The nature of the cough should be explored, although the history may be vague or unreliable. One consideration is that the language used by doctors and by the lay public is often quite different. Perhaps the most important quality of the cough is whether it is wet or dry. Children older than 6 years of age may be able to expectorate sputum, which confirms the productive nature of the cough and almost immediately excludes many other causes of cough. Children under 6 years of age are not usually able to expectorate, although it is worth asking if the family have ever captured a specimen before it has been swallowed. In this younger age group, the question may be better phrased as to whether the cough sounds like the child has ‘spit’ to cough up. A productive (sounding) cough is always abnormal and suppurative lung disease should be considered. Some coughs have a characteristic nature, such as the staccato cough of chlamydia trachomatis or the paroxysmal nature of pertussis. A lot of store is put on the presence of post-tussive vomiting with regard to diagnosing pertussis but, in infants in particular, almost any strenuous cough will result in vomiting. The barking cough of tracheomalacia is characteristic of this condition. This is readily heard amongst children with oesophageal atresia and TOF (often called the ‘TOF cough’) but it may be the only feature of tracheomalacia in some children. A honking, forced type of cough heard while waiting to see the patient is typical of a habit cough. The cough may not be a cough at all but a throat-clearing noise. Whether post-nasal drip fits this model is speculative\(^2\) but other considerations include habit or tics. A cough-like tic of Tourette’s syndrome has been misdiagnosed as chronic cough.\(^9\)

The circumstances around the onset of the cough are often helpful. Cough starting with a viral-type respiratory tract infection which then lingers may be a post-viral cough. It is important to find out if other family members or close contacts have a similar cough. Over 50% of infants with pertussis have a family member with laboratory confirmed or clinical pertussis.\(^10\) An infant in the first 4–8 weeks of life who has had conjunctivitis or a mother with vaginal discharge may have chlamydia trachomatis.\(^11\) The temporal association with feeding can be helpful when considering primary pulmonary aspiration, or the association with vomiting may link the cough to GOR and secondary pulmonary aspiration. Primary pulmonary aspiration may be due to a laryngeal cleft (usually associated with stridor) but is more commonly seen in children with low tone and poor bulbar function (e.g. Down’s syndrome, cerebral palsy). The history around a witnessed foreign body aspiration is often quite dramatic and is important in decision making regarding the need for bronchoscopy.

The timing of the cough can be a helpful feature, although as many as 5% of healthy children cough regularly at night.\(^12\) A cough that is strongest in the morning, associated with clearing of retained secretions overnight, is highly suggestive of suppurative lung disease. Cough that is worse on lying down (first retiring to bed) may be caused by GORD. Cough that is worse later in the night or the early hours of the morning may reflect reactive airways disease. This is most often thought of as asthma, although chronic non-specific cough of childhood does exactly the same as many of these children also have airway hyper-reactivity on formal testing.\(^13\) Finding out if the child sleeps through the night despite the cough can give a clue as to whether the parents are more affected by the cough but does not necessarily exclude serious pathology. Cough that goes away on going to sleep suggests a psychogenic cause (i.e. habit cough) and this can be proven by distracting the patient while awake.

Any additional respiratory noises, such as wheeze or stridor, should be sought. These make the presence of an identifiable cause of the cough more likely. Wheeze is usually associated with intrathoracic airway conditions, while stridor is usually associated with extrathoracic airway conditions.\(^11\) Again, it is worth being careful about lay descriptions of noises that may not be interpreted in the same way as by clinicians.
It is important to ascertain whether anything improves or worsens the cough. Many coughs are exacerbated by exercise and super-added respiratory tract infections that limits the usefulness of this question. Clearly a cough that repeatedly responds to a short-acting bronchodilator (within 1–3 min) is likely to be caused by asthma. The time course of systemic or inhaled corticosteroids makes it difficult to determine whether improvement is associated with natural history or related to a therapeutic response. Coughs that regularly respond to courses of antibiotics may be caused by suppurative bronchitis. A lack of response to antibiotics in a child who does have suppurative bronchitis does not necessarily rule this out, as the antibiotic courses offered are usually short in duration and compliance with therapy may be variable.

The family history of respiratory disorders may be relevant. Asthma and atopic disorders in the immediate family may lend weight to the cough being caused by asthma. A family history of cystic fibrosis, chronic bronchitis or even a very broad cystic fibrosis phenotype (unexplained liver disease, recurrent pancreatitis, infertile male relations) is worth pursuing. A smoking history should be sought. Adolescents smoking regularly may develop a ‘smoker’s cough’ related to impaired mucociliary clearance, while parental smoking (inside or outside the home) may exacerbate any tendency to cough. The social circumstances may be relevant, for example considering tuberculosis in migrant, indigenous and other socio-economically disadvantaged populations. Environmental factors such as household dust and moulds or pets should be inquired after; however, in the absence of well-defined associated diseases (e.g. allergic rhinitis or allergic alveolitis), they are difficult to ascribe to the cough. Medications such as angiotensin-converting enzyme inhibitors have been associated with cough.

It must always be remembered that patients can have multiple reasons for coughing. The classic pairing is the patient with asthma who also develops a post-viral cough. This can be interpreted as worsening of the patient’s asthma, inappropriately treated with an increase in systemic corticosteroids or even a very broad cystic fibrosis phenotype (unexplained liver disease, recurrent pancreatitis, infertile male relations) is worth pursuing. A smoking history should be sought. Adolescents smoking regularly may develop a ‘smoker’s cough’ related to impaired mucociliary clearance, while parental smoking (inside or outside the home) may exacerbate any tendency to cough.

The physical examination should be directed by the history. It is helpful to listen for the patient to cough spontaneously; failing this, one should ask the patient to cough. Vital signs and the degree of respiratory distress may give clues as to the acute nature of the underlying condition. Poor growth and nutrition is always of concern; if linked to the cough, they may be caused by increased metabolic demands from associated increased work of breathing or chronic infection. Dysmorphic features should be looked for. Many dysmorphic conditions are associated with poor bulbar function and pulmonary aspiration, while some have associated airway abnormalities such as tracheomalacia. Digital clubbing is most likely to represent chronic suppurative lung disease; however, in the absence of a moist cough, interstitial lung disease should be considered. The skin should be examined for eczema that may lend weight to the diagnosis of asthma.

Chest wall deformity is an indication of a chronic process. Pectus excavatum may be associated with extra-thoracic airway obstruction although there are few causes of chronic cough in this situation. If there is a chest wall deformity in association with the cough, it is likely to be a pectus carinatum, caused by a disease process associated with chronic small airways obstruction. Hyperinflation of the chest represents air trapping, usually caused by small airway disease. Percussion and auscultation of the chest will help distinguish localised (e.g. potential foreign body) or generalised processes and confirm the presence of adventitial noises. Noting the position of the heart by palpation and auscultation is relevant when suppurative lung disease is being considered. Dextrocardia makes primary ciliary dyskinesia more likely.

Examination of the ear, nose and throat is essential. Aural foreign bodies, wax or hair on the tympanic membrane have been associated with chronic cough and the presence of suppurative otitis media may be associated with suppurative bronchitis. The nose may be inflamed in atopic conditions and be a clue to lower airway inflammation such as asthma. The relationship with post-nasal drip is discussed elsewhere in this mini-symposium. Oropharyngeal foreign bodies may occasionally be seen by examination of the throat.

The physical examination should be completed by examining the abdomen. A palpable liver edge may confirm the presence of hyperinflation. Signs of chronic liver disease, particularly portal hypertension, may be features of cystic fibrosis. A large amount of stool in the abdomen or a right iliac fossa mass is not uncommon in cystic fibrosis, perhaps increasing the likelihood of such a diagnosis.

**Investigations**

The history and physical examination should determine the investigations. A chest x-ray (which should include the upper airway) and pulmonary function testing (children >6 years old) are usually all that may be needed to exclude a concerning cause for the cough. The value of routine allergy testing (radioallergosorbent test or skin-prick testing) is doubtful with regard to making a diagnosis. These tests may aid the management of asthma if this is considered to be the cause of the cough. Tests for suppurative lung disease are discussed elsewhere in this mini-symposium. Even in the presence of a supporting history of GORD, it is difficult to interpret the relationship between investigations such as barium swallow and pH probe and the cough. Other tests of aspiration such as video-assisted fluoroscopy and isotope milk scan are relatively specific but poorly sensitive. The yield from bronchoscopy or a computer tomography
scan of the chest is poor if the only symptom is cough. The one serological test that is occasionally useful is immunoglobulin A for pertussis, which can be used to convince a sceptical patient/parent. While the specificity is high, the sensitivity is poor.\textsuperscript{19} Evaluation for Mycoplasma pneumoniae and Chlamydia pneumoniae has an extremely low yield.\textsuperscript{20} Induced sputum has been used to diagnose eosinophilic bronchitis in adults and justify corticosteroid use for coughers,\textsuperscript{21} although the utility in children is less certain. Results of a bronchoalveolar lavage study comparing chronic coughers with controls (amongst others) did not find a difference in cell type.\textsuperscript{22} There is little to support the role of exhaled nitric oxide as an investigation for chronic cough.\textsuperscript{2,8}

**EMPIRIC THERAPY**

Empiric therapy for the treatment of cough or to help make a diagnosis is commonly recommended.\textsuperscript{2,7} This is justified if there is reasonable clinical suspicion of a diagnosis, the time course of the trial is limited and the expectations of the patient are realistic. Given that many coughs improve with time, successful treatment does not necessarily prove the diagnosis. Multiple trials of different therapy can re-inforce that a treatable pathology exists. Failure to respond to therapy can result in ‘doctor shopping’ with the possibility of ever-increasing doses of therapy and serious side-effects. This seems to be common in patients with asthma who also develop a cough; life-threatening complications have been reported.\textsuperscript{23,24}

**SPECIFIC COUGHS**

Some aspects of troublesome cough in children are not mentioned elsewhere in this mini-symposium and are worthy of consideration.

**Laryngotracheobronchitis (croup)**

The acute presentation of croup rarely poses clinical dilemmas. The cough is barking, reflecting the tracheal involvement, and often becomes moist after a few days, reflecting the bronchitic element. There appears to be an increasing trend for treating the cough with 3 days of oral corticosteroids, as per recommendations for asthma. The literature on corticosteroids and croup relates to the airway narrowing (stridor) and single doses of corticosteroids. Whether further doses influence the stridor is unknown, although it is logical to use repeat doses if stridor returns. It is unlikely that the corticosteroids have any effect on the cough.\textsuperscript{25}

**Foreign body aspiration**

It is important to recognise foreign body aspiration as permanent airway damage may result if not removed. The history of a choking episode followed by respiratory distress, wheeze or cough is enough to recommend bronchoscopy, irrespective of the chest x-ray findings. However, 50% of foreign body inhalations are witnessed.\textsuperscript{11} The initial cough may be dry and irritating. Once suppurrative lung disease is established, the cough becomes moist. Localised physical signs or chest x-ray findings in association with a cough warrant further investigation, usually with bronchoscopy to exclude the possibility of an inhaled foreign body. Chest x-ray taken in expiration increases the pick-up rate of inhaled foreign body diagnosis. If the history of foreign aspiration is unclear and there are no localised physical or chest x-ray findings, it may be best to start with a flexible bronchoscopy to find the foreign body before proceeding to rigid bronchoscopy for removal.\textsuperscript{26}

**Chronic pulmonary aspiration**

Chronic pulmonary aspiration is a common problem amongst children with poor bulbar control. The aspiration may be primary or secondary to GOR. The larynx may be irritated by the aspirated material, resulting in cough. However, this is not always the case and severely affected children may not have the protective reflexes to notice the aspirated material so there is no coughing or choking at the time of aspiration. The accumulation of aspirated material in the lungs may cause cough. This is often a dry, irritating cough but may progress to suppurrative lung disease with a productive cough. Associated airway noises such as wheeze often accompany chronic or recurrent aspiration. The symptom complex of cough and wheeze may be misdiagnosed as asthma. The biggest clue is the risk factor for poor bulbar control and a lack of asthma risk factors.

**Pertussis**

Pertussis is rarely difficult to recognise in the infant but is becoming an increasing problem amongst adults and adolescents. This is due to poor uptake of the vaccine a number of years ago and waning immunisation amongst those vaccinated.\textsuperscript{29} The characteristic features of the cough of pertussis are its paroxysmal nature along with the distress caused by the cough. The cough may last for many months and restart again with super-added viral respiratory infections. The serious problem with not recognising children or adults with pertussis is the risk of transmission to infants who have not had three doses of vaccine. An unpleasant feature of pertussis in the older child is nocturnal vomiting.

**Congenital airway disorders**

Tracheomalacia is the most common congenital airway disorder that may present with cough. The cough is usually dry and barking in nature and the parents notice that the child has always coughed like that. When the child develops the large positive pleural pressure required to gen-
erate the cough, the trachea collapses. This in itself may irritate the mucosa of the airway leading to more cough. Secretions may be retained behind the collapsing airway, contributing to more cough. Simple viral respiratory tract infections can prove troublesome for these reasons, prolonging the cough. In this setting, the differential includes chronic non-specific cough or post-viral cough, the tell-tale feature being the barking nature of the tracheomalacia cough.

The seriousness of tracheomalacia is related to the degree of respiratory distress and airway noises rather than the cough. One of the difficulties with the diagnosis of tracheomalacia, in the absence of other respiratory signs, is that there may be nothing to find at bronchoscopy. The malacia is only apparent when the child coughs and the child should not cough with a general anaesthetic or deep sedation for bronchoscopy. Mostly, the diagnosis of a tracheomalacia cough is made on clinical features alone.

**Gastro-oesophageal reflux disease**

It is a very attractive proposition to invoke GORD as a common cause for chronic cough. The possible mechanisms such as laryngeal soiling, pulmonary aspiration and reflex vagal-induced cough are difficult to deny. It can be difficult to establish a temporal relationship with episodes of reflux, even using 24-h oesophageal pH monitoring. In one adult study, only 35% of patients with chronic cough and abnormal pH studies responded to proton pump inhibition. Amongst infants, reflux is common, self limiting and is not usually associated with cough. Amongst children with poor bulbar control and low tone, aspiration (primary pulmonary or secondary to GORD) is more common than in healthy children. Investigations and/or therapeutic trials may be warranted. In many of these children, wheezing without response to bronchodilators (in addition to the cough) is common. Amongst otherwise healthy children who are not wheezy and with no history to suggest GORD, it is difficult to justify invasive investigations or therapeutic trials.

**CHRONIC NON-SPECIFIC COUGH OF CHILDHOOD AND POST-VIRAL COUGH**

Chronic non-specific cough of childhood is a common problem and is often quite distressing to the child and family. There are some good reviews on this topic but it is worth making a few points here. The chronic non-specific cough is usually dry and may be intermittent. It is generally worse at night; when associated with nocturnal waking, it becomes distressing to the family. Post-tussive vomiting is common but does not reflect more serious underlying pulmonary pathology. If the cough starts with a clearly defined viral respiratory tract infection, post-viral cough is a good label. Over 20% of healthy adults will cough for 2 weeks after a viral upper respiratory infection; this can persist for 8 weeks.

The problem for families and clinicians can be putting a label to the cough. In the absence of a clear aetiology, the temptation can be to continue investigations, many of which will be unhelpful and only serve to reinforce to the child and family that something is seriously wrong. A thorough history will confirm the positive features of the cough (dry, worse at night) and rule out most significant differential diagnoses. The child with chronic non-specific cough is always well nourished and there are no clinical findings. These facts need to be presented to the parents as positive features. It is usually worth performing a chest x ray and pulmonary function testing on those old enough to do the test. With a normal physical examination and basic tests of the airways and lung parenchyma, it is possible to reassure most parents.

The non-specific cough is not a reflection of lung damage and the cough itself will not damage the child. While the cough may not matter to the clinician, it does matter to the parents and a sympathetic approach should be taken. The concept of cough receptor sensitivity has been developed and provides clinicians with a ready explanation for concerned parents. With this model, there is an enhanced intrinsic response to cough stimuli that can be increased by environmental triggers (classically viral respiratory tract infections). Having limited the number of investigations, it is also important to limit the number of medications. There has not been an effective therapy for non-specific cough, including cough medications purchased at a pharmacy, antibiotics, bronchodilators or corticosteroids (systemic or inhaled). Prescribing medications can reinforce that there is something wrong. In many cases, the patient has already tried everything at presentation and the decision not to treat the cough is easier.

**CONCLUSION**

Cough presenting to the respiratory paediatrician always matters. Potentially, a treatable cause can be found through careful history, physical examination or appropriate investigations. Alternatively, at least a satisfactory label can be applied to the cough to prevent unnecessary investigations and treatment.

**PRACTICE POINTS**

- Chronic cough in children has different causes than in adults.
- A detailed history of the cough (nature, onset, duration, timing, associated respiratory noises, factors that worsen or improve the cough) is likely to reveal the cause.
Physical examination will often determine the severity of the underlying condition.
A chest X-ray and lung function (for children ≥6 years old) are likely to be the most valuable investigations.
Empiric therapy should be used with caution, with time limits and realistic expectations from the patient.
Multiple pathologies may co-exist, such as asthma and chronic non-specific cough/post-viral cough.

REFERENCES