Yardstick for Managing Cough, Part 1

In adults and adolescent patients older than 14 years of age

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INTRODUCTION:

This manuscript, part 2 in this yardstick series on chronic cough, will serve as a review and expert opinion on the diagnosis and management of chronic cough in the pediatric population (<14 years of age). For a review of diagnosis and management of cough in the adult population, we refer the reader to Part 1 of this series.[1] This manuscript will focus on chronic cough (lasting >4 weeks) in the pediatric population, and will not address acute and subacute cough which, unlike the chronic cough, have no randomized controlled trials (RCTs) to assess diagnostic validity. Clinicians need to be cognizant that the vast majority of the causes of pediatric acute coughs are benign (i.e., resolve spontaneously). However, cough is bothersome to both parents and the children and may represent the first presentation of an underlying lung disease that may progress to chronic cough in a subset of children.[2, 3] Thus, all children with chronic cough require careful evaluation. In fact, studies based out of specialist children's hospitals suggest that up to 30.8% of children presenting with acute cough may progress to chronic cough.[2, 4] This percentage, however, will likely be substantially lower for pediatric patients presenting to primary care with acute or subacute cough.

BACKGROUND:

Definition

Pediatric chronic cough is defined as a daily cough lasting >4 weeks. Reasons for this are based on the natural history of viral-related cough (which usually resolves within 4 weeks) and to ensure that a serious underlying condition is not missed.[5, 6] A multicenter study that used a cough algorithm found a serious potentially progressive underlying respiratory illness (e.g., bronchiectasis, aspiration lung disease or cystic fibrosis) in 18% of 346 children who presented to pediatric pulmonologists with chronic cough.[7] Similarly, published studies that

systematically assessed outcomes of individual children at a children's specialist hospital who had new onset cough that persisted for >4 weeks found a new and serious chronic lung disease (e.g. chronic pneumonia, bronchiectasis) in up to 30.8% children.[2, 3]

For cough management purposes, the age cut-off used in children is usually 14 years (i.e., before post-pubertal age.) which is suggested for many reasons, including maturational changes in lung anatomy, different age-related exposures (e.g., school or daycare exposures to viruses), and different medication related exposures.[5]

ETIOLOGIES AND DIAGNOSIS

To help identify the etiology of chronic cough in the pediatric population, clinicians should use a thorough history and physical examination that will aid in identifying diagnostic clues or pointers (signs, symptoms, comorbidities, test results). Once the diagnostic pointers (summarized in Table 1) are identified (if present), then the clinician can utilize well-characterized and evaluated cough algorithms (Figures 1 and 2) to aid in coming to a diagnosis.[4, 5] Utilization of these cough algorithms to identify and manage pediatric chronic cough has been shown to be effective in improving clinical outcomes in various settings (community primary care and specialties) utilizing observational studies and RCTs [8 9 4]

Field Code Changed

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Table 1: Diagnostic pointers to presence of specific cough* [adapted with permission from Chest 2020;158:303-29]

Abnormality	*Examples of etiology*
Comorbidities	
Cardiac abnormalities	Associated airway abnormalities, cardiac failure, arrhythmia
COVID-19	Possible long COVID syndrome
Feeding difficulties	Any serious systemic including pulmonary illness, aspiration
Growth failure	Any serious systemic including pulmonary illness such as cystic fibrosis
Immuno deficiency	Infectious etiologies, bronchiectasis
Other significant illness eg. History of oncological disorders, autoimmune disease	Increased risk of infections and other pulmonary complications eg. Bronchiolitis obliterans, interstitial lung disease

Neurodevelopmental abnormality	Aspiration lung disease
Previous history of chronic lung or esophageal disease (e.g. neonatal lung disease, esophageal atresia)	Multiple causes e.g. second H-fistula, bronchiectasis, aspiration, asthma
Recurrent pneumonia	Immunodeficiency, atypical infections, suppurative lung disease, congenital lung abnormalities, trachea-esophageal H fistulas
Exam Findings	
Crepitations	any airway lesions (from secretions) or parenchyma disease such as interstitial disease
Chest wall deformity	Any pulmonary airway or parenchyma disease
Digital clubbing	Suppurative lung disease
Wheeze – monophonic	Large airway obstruction (e.g. from foreign body aspiration, malacia and/or stenosis, vascular rings, lymphadenopathy, and mediastinal tumors. Tuberculosis should be considered in selected settings e.g. high prevalence or HIV
Wheeze – polyphonic	Asthma, bronchiolitis obliterans, bronchiolitis
Symptoms	
Chest pain	Arrhythmia, cardiac causes, asthma
Choking history (any)	Foreign body inhalation
Daily wet/productive cough	Protracted bacterial bronchitis, suppurative lung disease, recurrent aspiration, atypical infections, tuberculosis, diffuse panbronchiolitis
Dyspnea or tachypnea	Any pulmonary airway or parenchyma disease
Exertional dyspnea	Any airway or parenchymal disease
Facial pain/purulent nasal discharge	Chronic sinusitis (protracted bacterial bronchitis), primary ciliary dyskinesia
Hoarse voice/stridor	Laryngeal cleft/problems, airway abnormalities
Hemoptysis	Suppurative lung disease, vascular abnormalities
Hypoxia/cyanosis	Any airway or parenchyma disease, cardiac disease
Neonatal-onset symptoms	Usually reflects inheritable cause eg. Primary ciliary dyskinesia
Tests	
Chest radiograph (other than peribronchial changes) or spirometry abnormality	Any cardio-pulmonary disease and changes are dependent on cause e.g with RML syndrome, atelectasis or consolidation in right middle lobe or left lingula

*As the causes of chronic cough encompass the entire spectrum of pediatric pulmonology and extra-pulmonary diseases, this list outlines the more common symptoms and signs and is not exhaustive

~~Once the diagnostic pointers are identified (if present) then the clinician can utilize well-characterized and evaluated cough algorithms (Figures 1 and 2) to aid in coming to a diagnosis.[10] Utilization of these cough algorithms to identify and manage pediatric chronic cough has been shown to be effective in improving clinical outcomes in various settings (community primary care and specialties) utilizing observational studies and RCTs.[8,9,11]~~

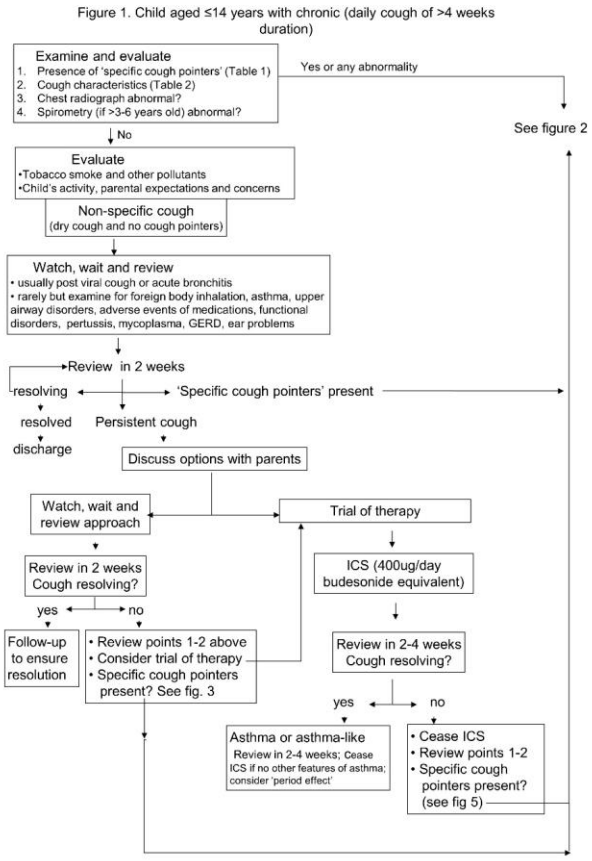

Figure 1: Approach to a child aged ≤14-years with chronic cough

The algorithm should be read with the accompanying text. *Spirometry can usually be reliably performed in children aged > 6-years and in some children > 3-years if trained pediatric personnel are present. [reproduced with permission from Chest 2020;158:303-29]

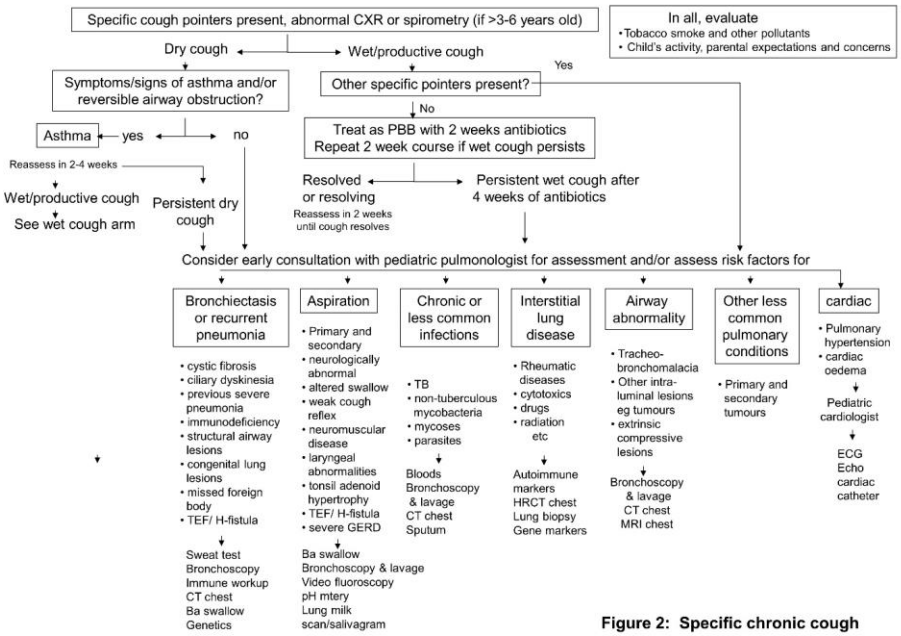

Figure 2: Specific chronic cough

Figure 2: Approach to a child aged ≤14-years with chronic specific cough (i.e., cough associated with other features suggestive of an underlying pulmonary and/or systemic abnormality).
*Children aged >14-years should be managed as outlined in adult guidelines but there is no good evidence where the age cut-off should be. [reproduced with permission from Chest 2020;158:303-29] PBB is defined as the presence of chronic wet cough in absence of other cough pointers and the resolution of the cough with 2-4 weeks of appropriate oral antibiotics.76

In addition to the diagnostic clues in table 1, the algorithm utilizes the nature of the cough construct to aid in diagnosis, utilizing non-specific cough and specific cough as described in detail below. In brief, non-specific cough refers to cough refers to dry, chronic cough with no identifiable pointers (Table 1) that likely resolves spontaneously while specific cough

is chronic cough that is not likely to resolve on its own and has a likely specific etiology that must be addressed to address the cough.

Non-specific Cough

When a dry, chronic cough is present AND in conjunction with a thorough history, examination, chest radiography and spirometry that do not reveal any specific cough pointers, it is highly likely that the cough will resolve spontaneously (termed non-specific cough). In the pediatric patient, this is most commonly due to effects from a prior viral illness, and it is appropriate to solely monitor and not actively treat the cough. However, attention should be made with respect to the impact of the cough on quality of life and environmental exposures (e.g. tobacco smoke) and the parents should be told to notify the clinician if the character of the cough changes or the child develops new symptoms that would warrant re-evaluation, as non-specific cough may evolve.

Even in the absence of specific diagnostic pointers, there are some etiologies of non-specific cough beyond post-viral cough that should be considered. The more common causes are detailed below.

Asthma

Chronic cough can be a presenting symptom in children with asthma. Classical asthma symptoms of polyphonic wheeze and/or dyspnea that responds to β2 agonist is part of specific cough (Table 1) but when these symptoms are absent, i.e. isolated chronic dry cough (i.e. in the absence of other suggestive symptoms or signs) is rarely due to asthma.[12, 13] Symptoms and signs suggestive of asthma include exertional dyspnea, bilateral recurrent wheeze, personal or family history of atopy (e.g., eczema). Spirometry demonstrating a reversible obstructive pattern and chest radiograph that shows bilateral hyperinflation, would support the diagnosis of asthma in a child with a chronic cough. When asthma is unequivocally diagnosed in line with asthma guidelines, they should be treated in accordance with asthma guidelines.

When symptoms other than cough are absent, the term 'cough-variant asthma' is sometimes used but 'cough-dominant asthma' is arguably a better term as asthma is often over-diagnosed in children with chronic cough.[12, 14]

Diagnostic steps beyond spirometry and chest radiograph could include tests of airway hyper-responsiveness (> 10% fall in FEV_1 with challenge test) and bronchodilator responsiveness (FEV_1 increase ≥12% following 400µg of inhaled β2 agonist).[15] In addition, the recent European Respiratory Society guideline for diagnosing asthma in children aged 5-12 years recommends measuring exhaled nitric oxide (FeNO) as part of the diagnostic work-up, with values >25 parts per billion as supportive of the diagnosis.[15] However, this remains controversial as it is not a recommendation in other guidelines and the precise cut-off is debatable.[16]

Even in situations of normal spirometry and chest radiograph, where further testing is not completed, a trial of asthma therapies may be considered in some children. If a trial of asthma medications is warranted, bronchodilators and low-dose inhaled corticosteroids (ICS) are recommended for a defined period (usually two to four weeks) before re-evaluation for response for the cough. A short-term higher ICS dose is suggested to prove/disprove the diagnosis with an adequate trial. It must be remembered that cough therapies demonstrate a significant placebo effect and non-specific cough will spontaneously resolve; thus, these asthma medications should only be continued if a definitive diagnosis is made. Failure to respond to the medication trial makes the diagnosis unlikely.

[17]Readers are referred to the pediatric asthma yardstick for further elucidation of this issue.[18]

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Gastro-esophageal reflux disease (GERD)

Although GERD is an important and common cause of chronic cough in adults, it is an uncommon cause, as opposed to an association, in children less than 15 years of age, except when aspiration is present.[19, 20] One systematic review found that GERD was found as a cause in only two of ten prospective pediatric chronic cough studies.[19] Furthermore it also difficult to prove GERD as the cause of chronic cough in children;[19, 21] in fact, 84% of coughs (as measured by a cough meter) were not temporally associated with a reflux event when measured concurrently with an esophageal pH monitoring device.[22]

Based on the above, a recent CHEST expert panel report recommended against treating children for chronic cough with anti-GERD therapy when no GI symptoms of GERD are present.[20] Evidence-based GERD-specific guidelines should be followed if GERD symptoms are present, which includes a trial of medications that is age-dependent and no longer than 4-8 weeks duration.[23]

Upper airway cough syndrome (UACS) and rhinosinusitis

While UACS or postnasal drip is thought to be a common cause of adult chronic cough, it remains a controversial cause in children. The most recent rhinitis guideline considers cough as one of the symptoms of rhinitis although the evidence is weak and considered a co-morbidity.[24] Intranasal corticosteroids (INCS) and intranasal anti-histamines are considered the appropriate first-line therapies for allergic and non-allergic rhinitis.[24]

It is possible, but remains unproven, that the cough associated with chronic rhinosinusitis is related to protracted bacterial bronchitis (PBB), and emerging clinical entity discussed in detail below. This concept is akin to the unified airways hypothesis with neutrophilic airway inflammation from nose to bronchus. The recommended treatment for acute bacterial rhinosinusitis in children includes antibiotics (amoxicillin[25] or amoxicillin-clavulanate[26] for 7-10 and 20[26] days respectively, not dissimilar

to PBB), and the common bacterial pathogens in sinusitis are identical to those in PBB.[27, 28] However, it remains to be determined whether the relationship between nasal secretions and cough is linked by a common etiology (infection and/or inflammation causing both) or due to clearing of secretions reaching the larynx.

Infections: pertussis and mycoplasma

It is always important to consider pertussis, which can present as non-specific cough, without the typical paroxysmal whoop, particularly in low income countries (which account for 95% of pertussis).[29] Classic pertussis has 3 stages: catarrhal, paroxysmal and convalescent but vaccination modifies the classical disease.[30] In one prospective study, 20% of children with chronic cough had evidence of recent pertussis infection, most of whom have been immunized, necessitating considering this disease even in those immunized[31] for public health reasons. We suggest that clinicians consider that the cough could be caused by pertussis if there is paroxysmal cough, post tussive vomiting, and inspiratory whooping in the acute phase of the illness or if there is history of contact.[30]

A retrospective study identified that the median duration of cough in children with positive mycoplasma serology was 39 days (95% CI 24-54).[32] Thus, mycoplasma is another possible cause of non-specific chronic cough in children. Unlike pertussis with public health consequences and the likelihood that antibiotics will be effective in the treatment of mycoplasma infection without pneumonia is debatable, identification of non-acute mycoplasma infection is less important as the effectiveness of antibiotics for this illness is controversial and one might suggest that this is not consistent with good antibiotic stewardship.[33]

Thus, even in cases where pertussis or mycoplasma are the cause of chronic cough, once the patient is at the chronic stage, there is little utility in treating with antibiotics.

Post-COVID syndrome

Although post COVID syndromes are rarer in children compared to adults,[34] chronic cough has been described as part of post-COVID syndrome (including long COVID) (5.4% of the 129 children who had COVID pre availability of vaccines[35]). However, in a meta-analysis, the pooled risk difference in post-COVID cases compared to controls demonstrated no significant difference between groups.[36] The authors also emphasized the importance of having a control group in studies involving children.[36]

Tic cough (previously referred to as habit cough) or somatic cough disorder (previously referred to as psychogenic cough or dysfunctional respiratory symptoms)

Tic cough can be brassy or barking like[37] but this cough characteristic can also signify tracheomalacia.[38] Tic cough is usually single repetitive cough and suppressible and often absent when asleep but no feature is fully diagnostic.[39] In contrast, cough related to tracheomalacia is not single/repetitive but occurs in bouts and present nocturnally and often wet.[40] Medications should be avoided, as treatment strategies can be relatively simple with the 'art of suggestion'.[41] Tic cough should not be confused with cough hypersensitivity and a suggested step-by-step approach to management has been described elsewhere.[42] In children, cough hypersensitivity as a diagnosis (unlike adults) is not appropriate for many reasons that is beyond the scope of this document. For further reading about the cough hypersensitivity syndrome, readers are referred to Part 1 of the cough yardstick on adults and adolescents.[1]

Non-pulmonary causes

Non-pulmonary causes of pediatric chronic cough include otogenic causes (Arnold's ear-cough reflex due to a foreign body irritating the external auditory canal), medications, and sleep disorders. These are rare causes in cohort studies that have evaluated the underlying etiology of chronic cough in the pediatric population.[19]

Medications can rarely be the cause of pediatric chronic cough. Examples include ACEI,[43] asthma medications immediately after inhalation,[44] psychostimulant medications

(e.g. dextroamphetamine resulting in new onset tics),[45] and etanercept[46] It has also been reported as a complication of chronic vagus nerve stimulation,[47] a procedure rarely undertaken in children. However, the reported prevalence of ACEI-induced cough is low in children (~2%);[48] and the cough resolves within days (3-7 days) after withdrawing the medication,[43, 49] and may not recur if the medication is reinitiated.[43]

Although sleep disorders (e.g., obstructive sleep apnea) as a cause of chronic cough is still controversial in children, its presence should be evaluated and managed accordingly.[5]

Treatment of non-specific cough

As stated above, non-specific cough is typically self-limiting and can be managed with observation alone. If an etiology such as those listed above is uncovered, then treatment of that underlying condition is warranted.

Using non-specific therapies to target cough (e.g., cough suppressants, anti-histamines, opioids), however, is not recommended. For example, the efficacy of anti-histamines in relieving cough in children is minimal, if at all, except when used to treat environmental (respiratory) allergies, and this is not recommended for empiric treatment of chronic cough in children.[50] As noted in a Cochrane review,[51] two therapeutic studies described no significant difference between the antihistamine and control groups with both achieving significant improvement.

Regarding other OTC cough medications, one systematic review[52] concluded that (other than honey) they have little, if any, benefit. Importantly many OTC preparations contain antihistamines and dextromethorphan that have been associated with adverse events. The use of OTC medications has to be balanced with adverse events, which includes reported death from toxicity in young children.[53, 54] In fact, in 2018, the FDA altered the labeling for prescription opioid cough and cold medicines to limit their use to adults ≥18-years.[55]

Although still used widely, there is a decreasing trend in US in the use of OTC medications for cough, excluding anti-histamines that have actually increased.[56]

Specific Chronic Cough

In specific cough (vs non-specific cough), there is an identifiable underlying abnormality or cause and the cough may be dry or wet/mixed with the presence of other symptoms. Cough "pointers" (Table 1) can be used to identify a likely underlying cause for the cough, with each pointer having different specificity and sensitivity and associated likelihood ratios,[57] and will invariably be setting-dependent. Importantly, an absence of all of these "pointers" makes a specific cough very unlikely with a strongly negative likelihood ratio of 0 (95% CI 0, 0.03).[57]

As the specific cough etiologies cover the entirety of pediatric respiratory illnesses, it is not possible to list all the etiologies. Table 1 lists several cough pointers and their associated etiologies. The more common causes are briefly listed below.

Protracted Bacterial Bronchitis (PBB)

PBB is the most common etiology of chronic cough in some settings[19] and may be an underestimated cause of chronic cough in other settings.[58] PBB is now an internationally recognized diagnostic entity.[17, 27, 59] Its diagnosis requires 3 criteria: (a) presence of chronic wet/productive cough (>4-wks), (b) cough resolution with 2-4 weeks of appropriate oral antibiotics,[60] and (c) absence of other causes of chronic wet cough.[17, 60] However, chronic wet cough is the key presenting symptom in other conditions, such as bronchiectasis.[27] Both PBB and bronchiectasis have some shared pathology such as lower airway bacterial infection with inflammation.[60] They are on a continuum with shared and graded clinical and pathobiological features (e.g., airway gene expression profiles[61] and phagocytic dysfunction[60]).

Children with PBB are typically young (median age 1.8-4.8 years) but it also can occur in older children (>12 years).[60] They may have or examination may reveal a "rattle" on

chest auscultation, thought to be secretions moving in the large airways. Children with PBB are otherwise healthy with normal growth and development with a chest radiograph that is normal or shows non-specific changes of peribronchial thickening. Their spirometry values are normal.[60] Compared to controls, their exposure to tobacco is not elevated. Also, atopic features, clinical history (such as eczema, rhinitis), elevated total IgE, positive test for specific serum IgE or positive skin prick test for aeroallergens, are similar in children with PBB and control groups.[14] Risk factors for developing PBB following an acute respiratory infection are young age (<12-months: adjusted relative risk [aRR]=4.31, 95% CI 1.42-13.10; 12-<24 months: aRR=2.00, 95% CI 1.35-2.96), childcare attendance (aRR=2.32, 95% CI 1.48-3.63), and prior history of chronic cough (aRR=2.63, 95% CI 1.72-4.01).[62]

Treatment is 2 to 4 weeks of amoxicillin-clavulanate[17, 63] (that treats the most common bacteria found in PBB i.e. *Haemophilus influenzae, especially non-typable H. influenzae, Streptococcus pneumoniae and Moraxella catarrhalis).* A recent RCT finding that there was no difference in cough resolution between children with chronic wet cough randomized to 2 or 4 weeks of antibiotics.[64] While those who received 4 weeks had a longer cough-free period,[64] there is currently insufficient data to recommend a 4 week course in all children suspected of having PBB. Trimethoprim-sulfamethoxazole is an alternative when penicillin allergy is present. Although we are aware that azithromycin has been used, there is currently no published data on its efficacy for PBB.

As children with PBB may later develop bronchiectasis, we suggest that parents should be counselled regarding this potential sequela. In children with PBB who had flexible bronchoscopy undertaken, those with lower airway *H. influenzae* and recurrent PBB (>3 episodes/year) were at risk of having bronchiectasis in the next 2 years.[65] By 5 years, these independent risk factors were confirmed but a new finding of asthma was also described.[66]

Bronchiectasis

Pediatric bronchiectasis was previously defined by imaging alone and considered irreversible, but in the current era it is now defined as the presence of a clinical syndrome (chronic or recurrent wet/productive cough, with or without other features such as growth failure, exertional dyspnea, feeding difficulties, coarse crackles on chest auscultation or digital clubbing) with evidence of radiological abnormal airway dilatation (broncho-arterial ratio (BAR) of >0.8) on chest CT scan.[27, 67] The hallmark is abnormal increased BAR given the appearance of a signet-ring appearance, but other radiological features (e.g. bronchial wall thickening and failure of bronchial structure to taper toward lung periphery) may also be present.[27]

Bronchiectasis is a heterogenous disease and has varying etiologies from various insults, including: cystic fibrosis, post-infectious (tuberculosis, adenovirus, severe pneumonia), post-transplant, immunodeficiency, primary ciliary dyskinesia, aspiration lung disease and foreign body inhalation.[27, 68] Having a high level of suspicion, leading to early diagnosis and optimal management is important in children as it leads to better outcomes, including radiological abnormality improvement or even reversal.[27, 67] Currently, there is still a lack of awareness in the general community and increasing it is a priority expressed by parents of children with bronchiectasis.[69]

All children with, or suspected of having bronchiectasis should be evaluated with at least a computed tomography (CT) chest scan with high resolution and obtaining an airway specimen, and a panel of tests as a minimum.[27, 67] This panel of tests include a sweat test and basic immunology to evaluate for the presence of cystic fibrosis and common primary immunodeficiencies.[27, 67] Other tests (eg those specific for PCD and genetic tests) are based on the clinical setting and clinical features may also be required and readers are referred to bronchiectasis guidelines.[27, 67] Thus, they should be referred to a specialty center, under the care of a multi-disciplinary team.[27, 67]

Chronic Lung Infections

Infections such as tuberculosis, hydatid disease, non-tuberculosis mycobacteria and parasitic infections should be a consideration in endemic areas. For example, a Hungarian study reported toxocariasis associated with chronic cough in childhood in 32% of the 425 children evaluated.[70] Readers are referred to the CHEST guideline on chronic cough related to tuberculosis.[71]

Immunodeficiency

Likewise, children with immunodeficiency (primary or secondary) should also be evaluated in accordance with local protocols as most of these children will need further targeted evaluation (such as chest CT scan and flexible bronchoscopy). These children require specialist review and details are beyond the purview of this yardstick.

Right Middle Lobe Syndrome

Right middle lobe (RML) syndrome (recurrent or chronic collapse of the middle lobe of the right lung or lingula) may or may not be of infective origin but can present with chronic cough. Children with RML syndrome should always be carefully evaluated for tuberculosis, asthma and the majority require a flexible bronchoscopy to ensure it is not related to an obstructive lesion.[72] It is easily diagnosed on a chest radiograph. Like bronchiectasis, early diagnosis of the underlying cause and timely management is important for better long-term outcomes.

Anatomical Airway Abnormalities

In the evaluation of a child with chronic cough, tracheo-bronchomalacia should always be considered. Children with major anatomical airway lesions such as tracheo-bronchomalacia are at risk of frequent and prolonged cough,[73] as well as PBB and bronchiectasis.[74] , A prospective study found 68% of children with PBB had tracheo-

bronchomalacia.[14] However, this was no higher than that in the control group (53%) that consisted of children undergoing bronchoscopy for reasons other than chronic cough.[14]

It is highly unlikely that the tracheo-bronchomalacia itself causes the cough but rather that the cough is a consequence. Airway malacia impedes clearance of secretions[75] and it is plausible that the prolonged cough in these children relates to a bronchitic process distal to the lesion. A prospective study[73] of children with malacia found increased likelihood of respiratory illness frequency, severity, significant cough and a tendency for delayed recovery but neither the site nor severity of malacia had an effect on respiratory illness. Systematic reviews[17, 40] of available studies show that the relationship between airway lesions and cough is not straightforward.

When tracheomalacia is present, the cough is typically brassy or barking.[38] While there are different modalities to diagnose tracheo-bronchomalacia,[40] the most commonly used is flexible bronchoscopy that also allows obtaining broncho-alveolar lavage for assessment of lower airway infection. Management of children with tracheo-bronchomalacia is individualized, based on the child's clinical history.[40]

Aspiration lung disease

Recurrent small volume aspiration is a potential cause of chronic cough and should be considered particularly in children with neurological, neuromuscular and developmental disorders.[76] Typically, there is a history of coughing with feedings but silent aspiration occurs in up to 28% of children with severe neurological dysfunction.[76] Thus, absence of coughing with feeding does not imply aspiration is not the cause of the chronic cough in a child with neurodevelopmental disorders.

Aspiration may also be secondary to gastroesophageal reflux, tracheoesophageal fistula or laryngeal cleft. Evaluation for primary aspiration requires swallow assessment such as video fluoroscopy/ modified barium swallow. Sometimes, other modalities such as

bronchoscopy with broncho-alveolar lavage and assessment of esophageal function may also be required. Management of aspiration is highly individualized and should be undertaken by a multi-disciplinary team that includes speech pathologists.

Inhaled airway foreign body

All children with chronic cough should be assessed for possible retained airway foreign body. While more common in young children (aged <5 years), it also occurs in older children.[77] By the time chronic cough develops post inhalation of a foreign body, the cough is typically wet, but may occasionally be dry, especially at initial presentation. A history of onset of cough following a choking episode should be sought. Chest examination may demonstrate signs of asymmetrical breath sounds and focal sounds, most commonly a monophonic and unilateral low-pitched wheeze. Chest radiograph may show unilateral lung hyperinflation consistent with bronchial obstruction, which becomes more apparent on an expiratory film and occasionally the foreign body itself may be seen on the plain film. However, a normal chest exam or chest radiograph do not exclude the presence of an inhaled foreign body. Immediate referral to specialist care for bronchoscopy is warranted if there is a suggestive history, as longer retention of a foreign body is associated with poorer outcomes.[78]

Cardiac causes

While heart failure in adults may present with cough, this is rarely the presenting symptom in children. Children with congenital heart disease have a higher risk of respiratory tract infections and primary ciliary dyskinesia, but cough in these conditions is usually wet.

CONCLUSIONS:

While chronic cough in children is often benign and self-limiting, in some cases it can represent a serious underlying condition. Utilizing established and validated protocols as well as specific pointers (clues in history, findings on exam) can aid the clinician in identifying causes when present and improve outcomes.

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