

# **Cough**

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### **Introduction**

- Most common complaint for which patients seek medical attention.
- cough can so profoundly and adversely affect the quality of patients' lives
- Most children with cough do not have a serious lung condition
- Coughing can be troublesome and difficult to treat
- In the USA, approximately \$2 billion per year is spent on cough and cold remedies.
- A national US survey reported that a 35% of 8,145 pre- school-age children had used OTC for cough in the past 30 days.
- This corresponds to the most frequently and third most frequently used medications in the respective age groups!
- A study in which cough was measured objectively found that healthy children of mean age 10 years have, on average, 10 cough episodes (range up to 34) per 24 hours mostly during the daytime.
- It is likely that younger children will have more infections and, hence, more coughing
- cough can be:
  - acute, < 3 weeks
  - subacute, lasting 3-8 weeks
  - chronic, lasting > 8 weeks

### **Problems**

- While "cough" is a precise symptom, its severity is often not objectively reported.
- No objective measure to report nocturnal cough Studies (overnight audio recordings have shown that parental reporting of cough is not reliable)
- Cough scores on diary cards have never been validated
- Difficult to use therapeutic trial in a condition that may resolves spontaneously

### **Physiology**

- Lung defense:
- Mucociliary escalator: thin mucus
- Cough:
  - Large amount of inhaled material
  - Large amount of mucus (↑ production or ↓ clearance)
  - Large amount of abnormal substance (edema, pus)

### **Cough reflex: Receptors**

- Rapidly adapting irritant receptors
- Nerve endings in the epi throughout the resp. system (laryngotracheobronchial) (chemical and mechanical).
- esp. present in the post. wall of the trachea, carina, branching points of large aw, less in the distal aw
- Also in pharynx, ext. ear canal, ear drum, sinuses, diaphragm, pleura & stomach. (mechanical).

### **Cough reflex: Trigger**

- Mechanical: touch displacement
- Chemical: noxious gases and fumes
- Adaptation occur (more rapid for mechanical)

#### **Cough reflex: Afferents**

- Vagus: Main
- Less glossopharyngeal, trigeminal, phrenic nerves
- Higher center: voluntary control.
- Stimulate cough center and may stimulate mucus glands (protective barrier against stimulant).

#### **Cough reflex: Cough center**

- Does it exist?
- Diffusely located in the medulla oblongata (pons)
- Separate from the respiratory control center
- Blocked by opiates
- probably the, and is also influenced by voluntary control
- When the conscious state is depressed, the cough reflex is diminished, although not be directly related to the Glasgow coma score

#### **Cough reflex: Efferents**

- In the ventral respiratory group
- Sending motor neurons to the inspiratory and expiratory muscles through the phrenic nerve and spinal motor neurons from C3 to S2, the recurrent laryngeal nerve (for glottic closure), and the spinal nerves
- Also the vagus to the larynx and aw smooth muscles.

#### **Cough reflex: Physiology**

- Initial inspiration (not always)
- Expiratory phase
- Glottic closure at the first 0.2 sec of the exp. Phase (high intra-thoracic pressure)
- Opening of the glottis → High exp flow rate
- Dynamic compression of the aw increases the velocity.
- Vibration of the aw clears the mucus.

#### **Beneficial effect of cough**

- An important defense mechanism
- Maintain airway patency by clearing secretions
- Maintain consciousness in lethal arrhythmias, convert rhythm and a form of CPR

#### **Complications**

##### **CVS:**

- Hypotension
- LOC
- Venous rupture causing hemorrhage (nose, subconjunctiva)
- Arrhythmias
- Catheters

##### **CNS**

- Syncope, seizures
- Headache

- CSF leak, air embolism
- Stroke
- VA shunt malfunction
- Acute cervical radiculopathy

**GI:**

- GER
- Splenic rupture
- Inguinal hernia

**GUS:**

- Incontinence
- Bladder prolapse

**Musculoskeletal:**

- Rib fracture
- Increase CPK
- Rupture of rectus abdominis

**Respiratory:**

- Air leak (PIE, subcutaneous emphysema pneumomediastinum/pericardium/pertonium, pneumothorax)
- Laryngeal trauma
- Tracheobronchial trauma
- Intercostal lung herniation
- Asthma exacerbation

**Others**

- Petechiae and purpura
- Surgical wound disruption
- Constitutional symptoms: hoarseness, MS pain
- Life style changes
- Fear of serious disease
- Quality of life changes
- Self consciousness
- Exhaustion
- Insomnia
- Spread infection

**Causes:**

**PND**

- Secretions from nose and sinuses → mechanical stimulation → cough
- Due to sinusitis and various causes of rhinitis (infection, allergic)
- Commonest cause of chronic cough in adults (8-87%)
- Non-specific findings (cough, throat sensation cobblestone appearance of the throat, mucus in the pharynx)
- Treated by combination of first generation antihistamine & decongestant + Rx of the cause.
- Although some groups have stated that sinusitis/ postnasal drip is a common cause of cough:

- There are no cough receptors in the pharynx or postnasal space
- although sinusitis is a common condition in childhood, it is not associated with cough
- Plain sinus radiographs are not specific and sensitive
- Abnormal sinus radiographs may be found in 18-82% of asymptomatic children.
- The relationship between nasal secretions and cough is more likely linked to a common etiology

### **Asthma**

- CVA is first described in 1972 by Glauser
- Asthma present only with cough (CVA) in 6% of new asthmatic in a tertiary care center. (6.5-57%)
- Cough occurs in all asthmatics
- It is one of the most common cause of chronic cough (43%).
- Diagnosed by symptoms and signs, PEF, PFT, BHR, therapeutic trial
- Treatment:  $\beta$  agonist & ICS +/- oral steroids & environmental control.
- Medication should be delivered by DPI or MDI + spacer
- Maximum effect of treatment will take 6-8 w.
- Although a trial of asthma medications may be considered,
- if the cough does not respond to the asthma therapy, the diagnosis must be withdrawn and the medications stopped.

### **GER**

- One of the common causes of chronic cough
- Vagally mediated distal esophageal tracheobronchial reflex.
- No GI symptoms in 75% of cases.
- Cough from other causes can precipitate reflux and
- Most sensitive test is 24 hr esophageal pH monitoring
- If not available, empiric treatment after excluding other causes of cough
- Failure to respond to empiric treatment does not exclude GER
- Aim:
  - Decrease the frequency and duration of the reflux
  - Decrease the irritative nature of the gastric secretions
- Medical therapy
  - Response may not be seen before 2-3 m
  - success to treat cough 70-100%
  - Life style changes
  - H2 blockers
  - Proton pump inhibitors
  - Prokinetic agents
- Surgery:
- The adult literature suggests that approximately 21 % of adults
- Cough and GER can each precipitate the other and to prove the link between the two is difficult
- The view that GER is a frequent cause of cough has been challenged by several groups who have found that GER is neither a specific nor frequent cause of chronic cough

- In a French study, antireflux treatment was no better than placebo in the treatment of children with GER and nocturnal cough.
- Infants regularly regurgitate yet few,

### **Bronchiectasis**

- 4% of chronic cough
- Abnormal pathology of the airway especially subsegmental bronchi.
- Can be:
  - Cylindrical: simple dilatation no loss of contour
  - Varicose: patch destruction of the cartilage
  - Cystic: ballooning to form a cyst
- Damage is a result of interaction between an insult and host defense.
- Not a diagnosis
- Cough with sputum (rarely dry cough B sicca)
- Diagnosis: CXR, HRCT.
- **Treatment:**
  - Cause
  - CPT & PD
  - BD and theophylline
  - Mucolytics / ICS
  - Antibiotic:
    - Treat exacerbation
    - Prophylaxis
  - Surgery
  - Transplant

### **Post infectious cough**

- 22% of preschool children reported chronic cough without colds
- Can be prolonged (eg chlamydia, pertussis)
- Pathogenesis ? Transient airway inflammation +/- BHR.? And increased cough receptor sensitivity (CRS)
- Diagnosis by exclusion
- Treatment: systemic steroid, ICS, antibiotics. BD, ITB treat contact

### **Aspiration**

- Palatopharyngeal incoordination
- Esophageal dysmotility
- TEF (H type)
- Laryngeal cleft
- Vocal cord paralysis
- Over feeding
- Thickening of the feed (*Orenstein, J pediatr 1992*)

### **Foreign body**

- Airway or esophageal
- Symptoms can be delayed for more than 1 week (20%)
- Cough is common
- May remain asymptomatic till infection develop
- Mobile FB can cause paroxysmal cough

### **Congenital anomalies**

- Vascular ring and sling
- Tracheobronchial malacia
- Cystic lung disease

### **Psychogenic cough**

- Chronic dry cough without evidence of underlying illness.
- 3-10% of chronic cough
- persists after a simple URI
- May present as:
  - a habit "tic-like" cough (a dry repetitive and purposeless cough) not associated with psychological problem
  - as a bizarre "honking" cough
- the child is indifferent to the cough but the parents are usually extremely worried about it.
- the symptoms typically disappear during sleep or the child is engrossed in an activity but becomes more noticeable with attention.
- Characteristically, these children are >5 years, bright students
- Often suffer from other somatic symptoms
- In many cases the cough is a manifestation of underlying stress
- It is diagnosis of exclusion
- Usually there is cough in the family or the child has an underlying respiratory problem.
- Cough can cause irritation of airway leading to more cough
- Family life and school attendance are disrupted
- Approach to treatment ranges from benign neglect/suggestion therapy (shifting the focus away from the symptom) to psychiatric intervention

### **ILD**

- Diffuse infiltration of the alveolar and or the interstitial spaces by inflammatory cells or fluid.
- Dyspnea is more frequent than cough
- If cough is prominent look for concomitant asthma, GERD and PND.
- Due to irritation or involvement of the small airway
- Diagnosis by CXR, HRCT, BAL, PFT, Bx.

### **Others:**

- Ear:
  - FB, impacted cerumen, fluid middle ear
  - Via the Arnold nerve (vagus)
- Heart:
  - Cyanotic heart disease
  - Pressure in the airway by the congested vessels, left atrium or edema.
- Mediastinal tumor

### **Environmental**

- Passive smoking
  - Risk factor for LRTI & chronic cough < 2 Y
  - Long term PFT changes (↓ FEV1)
- Volatile substances, wood burning, kerosene heater, dry heating, fresh paint, new carpet & new furniture

- Astringent in the nose or rubbed in the chest.
- Active smoking

### **ACE inhibitors**

- Irritating cough with tickling sensation in the throat
- All ACEI if develop with one will develop with others
- No lung dysfunction
- Occur in 10% more in females
- Not dose related
- Not more in asthmatics
- Onset: few hours to weeks or months
- Resolution takes weeks
- ACEI → inflammatory mediators (PG, BK, sub P) → cough reflex sensitivity
- Attenuated by indomethacin, nifedipine)
- Losartan (angiotensin II receptor antagonist) does not cause cough
- Treatment: Stop the medication

### **Approach to cough**

- **History:**
  - Feeding history
  - FB aspiration
  - Allergy
  - Neonatal history
  - Immunization
  - Family history of asthma, TB, CF...
  - Environment: Home, school.
  - Medications
- **Physical examination:**
  - Growth
  - ENT, chest, clubbing, BCG scar, CVS, atopic features
  - ask the child to perform his/her usual cough

### **Investigations**

- Review previous tests
- CBC
- CXR
- Ba, pH monitor
- Bronchoscopy
- PFT, provocation test, PEFr
- Sputum
- PPD +/- anergy test
- Sweat chloride
- Ig
- Cilia studies
- Therapeutic trial

### **Treatment**

#### **Specific treatment:**

- treatment of the cause and environmental control

- Cause can be determined in 84-100% of the cases
- If the cause is found treatment will be successful in 84-98%
- Some times more than one etiology, treat sequentially or if partial response additionally.
- Use systemic approach
- Most children with cough do not have a serious lung condition
- other rarer disorders should be excluded whenever
  - cough appears unusually severe and/or frequent,
  - evidence of failure to thrive and growth retardation.
  - The younger the child, the more the need to exclude underlying disease at an early stage.

### **Non-specific treatment:**

Two types: Antitussive therapy

- Protussive therapy

### **Antitussive therapy:**

- Two thirds of parents "believed that their children needed medicine for cold symptoms."
- common misconceptions are that cough and cold medicines cure common colds.
- No assurances that these medications are used correctly
- Absence of efficacy data on cough and cold medicines in children
- The high use rate of these medications may be a tremendous waste of money and may unnecessarily expose children to toxicity. Kogan et al
- Cough suppression may adversely affect the patient
- Given if the cough has no useful function
- Has limited role
- Treat symptoms, not the underlying pathology
- Control the cough but do not eliminate it
- Used only if
- the etiology is not known
- specific therapy can not be given
- Specific therapy has not had a chance to work or will not work
- Antihistamine-decongestant combinations: no more effective than placebo or no treatment in improving cough symptoms (Clemens CJ, J Paediatr 1997; Hutton N. J Pediatr 1991).
- Neither dextromethorphan nor codeine was more effective than placebo (Taylor JA. J Paediatr 1993)
- These medications can be harmful
- Decongestant: irritability, restlessness, lethargy, hallucinations, hypertension, dystonic reactions)
- Clearance of these medications varies with age (esp. < 6 m).
- Metabolism can be altered by concurrent medications (acetaminophen).
- Dosing are based on extrapolation from adults.

### **AAP Committee on Drugs Recommendations**



The Committee considered very carefully the few articles that have been published and remains impressed by the reports of adverse events in children receiving codeine. We were also impressed by the lack of efficacy of any of the components in cough preparations, including codeine, dextromethorphan, antihistamines, and decongestants. We certainly support the relief of symptoms as an important part of pediatric therapeutics. It is disappointing to find no efficacy for cough preparations..

1. No well-controlled scientific studies were found that support the efficacy and safety of narcotics (including codeine) or dextromethorphan as antitussives in children. Indications for their use in children have not been established.
2. Suppression of cough in many pulmonary airway diseases may be hazardous and contraindicated. Cough due to acute viral airway infections is short-lived and may be treated with fluids and humidity.
3. Dosage guidelines for cough and cold mixtures are extrapolated from adult data and clinical experience, thus are imprecise for children. Adverse effects and overdosage associated with administration of cough and cold preparations in children are reported. Further research on dosage, safety, and efficacy of these preparations needs to be done in children.
4. Education of patients and parents about the lack of proven antitussive effects and the potential risks of these products is needed.

#### **Why do mothers consult MD when their children cough?**

- A major concern for mothers was their fear that their child was going to die (because of choking on phlegm or vomit, but also through an asthma attack or cot death).
- Mothers were also worried that their child would develop long-term chest damage.
- Mothers experienced disturbed sleep because of these worries. (Cornford CS Fam Pract 1993)

#### **Messages we should deliver to Parents**

1. preschool children may experience 4-8 episodes per year of viral URI.
2. there are no cures for this viral infection
3. most of these infections are self-limited and resolve in 5 to 7 days
4. cough and cold medications have not been shown to work and may produce adverse effects or toxicity in young children, particularly infants.
5. Although they may be annoying or worrisome to the parent, the symptoms of upper respiratory tract infection, particularly cough, may not be distressing to the child

#### **Lidocaine inhalation for cough suppression.**

- Nebulized lidocaine, preceded by standard nebulized albuterol inhalation driven by oxygen was given to suppress cough in a selected group of patients with intractable cough
- nebulized lidocaine was very effective in suppressing cough, and thus buying time for more definitive therapies to work