

How Therapies Work in Mucociliary Clearance (MCC)

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Introduction

Mucociliary Clearance refers to the system which employs cilia to move entrapped bacteria, dust, toxins and allergens out of the respiratory system. The purpose of this article is to describe factors that enhance, stimulate, and improve mucociliary clearance, and explain the mechanisms by which they do so. There are two parts: the outer gel area and the inner sol layer that contains the cilia. In the upper respiratory system, the gel is moved from the nasal/sinus area to the nasopharynx, then to the stomach. In the lower respiratory system, it is moved up the trachea to the throat, where it is swallowed, and inactivated by the stomach. The cilia move in synchrony in the inner sol layer. This movement moves the outer gel layer that contains goblet cells, mucin (glycoprotein), IgA, albumin, lactoferrin and lysozyme. Therapy may be directed to the cilia, or the gel layer or both [1-5].

Many of the therapies have been validated by performing the Saccharin Test. This consists of placing a particle of saccharin on the medial surface of the inferior turbinate, one cm posterior to the anterior end. Then the patient is asked to swallow every 30 seconds, until she tastes the sweet taste. If there is no response after an hour, place saccharin on the tongue to determine if the taste sense is viable. Normally the saccharin is tasted in 5 - 10 minutes.

Saccharin Test Times

- 1-4 minutes: Acute Allergy
- 5-7 minutes: Normal MCC
- 9-15 minutes: Infection
- 16-28 minutes: Chronic Infection
- 30 + minutes: Irreversible poor MCC

This is a useful clinical test that can determine if MCC is impaired. It can be used to test a therapy. It is of particular value in identifying sources of MCC impairment, such as industrial products, inhaled solvents, Chromium, SO₂, Hyperbaric Oxygen,

and many others. Directing therapy to mucociliary clearance offers a system of therapy that is outside of culture, sensitivity and antibiotics. Therapies for MCC include:

a)Antibiotics: Added to Pulsed Irrigation. Mupirocin and most antibiotics have been used via Pulsed Irrigation. Lee reports, that after literature search, there is no specific study indicating effectiveness of adding antibiotics to simple irrigation, except personal reports.

b)Breathing Exercises: Deep breathing rhythmic exercises help most lower respiratory conditions.

c)Bronchodilators: Such as theophyllin generally increase MCC.

d)Chicken Soup: Benefits by thinning mucus and enabling increased cilia movement. When compared with hot water itself, chicken soup definitely increased nasal mucus velocity and aided nasal airflow resistance.

e)Corticosteroids: Generally increase MCC.

f)Dornase alpha: (Pulmozyme) contains human deoxyribonuclease, an enzyme that selectively cleaves DNA. It hydrolyzes the DNA present in the mucus of CF patients, which reduces the viscosity of mucus in the lungs.

g)Fluid Intake: Reduced intake of fluids will thicken mucus and thereby slow MCC. First thing to do for cold, sinusitis, or cough is to increase fluids.

h)Green Tea: Supplies epigallocatechin-3-gallate (EGCG) known for anti-inflammatory effects. EGCG suppresses the gene and/or protein expression of inflammatory cytokines and inflammation related enzymes.

i)Humming: Chest thumping and vibration devices. Humming at a low tone - frequency -, such as "ooomm", sets the mucus in motion, to break up mucus bonds. The vibration assists cilia return to normal. In the chest, rhythmic thumping

can similarly shake loose obstructive mucus. For therapy, humming should be for a period of at least two hours over a 24 hour period [6,7].

j) Hypertonic Inhalation: Is used for Cystic Fibrosis to thin the thick mucus.

k) Jumping Jacks: The athletic movement with thumping helps break the mucus bonds.

l) Neti Pot: Is useful for thinning the thick mucus associated with sinusitis.

m) Proteolytic Enzymes: These include Papain and Bromelain. These thin mucus and reduce swelling. Ideally these are best melted in the buccal pouch to avoid stomach inactivation. Clear:ease™, is taken 1 QID, dissolve in buccal pouch. It is a measured Bromelain/Papain combination.

n) Pulsed Irrigation: Here the rate of pulsation is used to maximize normal cilia movement. In addition, a pulsed irrigation is more effective in thinning mucus. The steady flow of a motorized irrigation maximizes the Bernoulli effect, to withdraw sinus contents. Once MCC is restored to normal, there is no need to continue irrigation.

o) Steam Inhalation: With tongue extended - warmth speeds cilia movement; moisture helps thin the mucus.

p) Surfactants: University of Cincinnati - S. Isaacs - used Johnson Baby Shampoo 1% and found it useful for removing biofilm.

q) Temperature: Cold air reduces CBF - cilia beat frequency. This is why colds and respiratory infections increase in winter; going directly from cold outside to classroom, allows bacteria to remain in the respiratory system. Better to warm

the nose/chest by inhaling from the cupped hand before entering the crowded elevator.

Conclusion

Whether you are treating the thickened mucus or the impaired rate of cilia, most therapies directed to only the upper respiratory system also effect the other lower respiratory system. Significantly, when impaired MCC is improved, the need for systemic antibiotics may be significantly reduced. In our world of increased antibiotic resistant, this can be of major assistance to the health of the patient. The author has detailed the mechanisms by which MCC can be enhanced in order to insure better compliance of the doctor's recommendations. With greater compliance, comes better healing.

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