**Airway Mucus Hyper secretion and Its Management through Exercise Interventions**

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**Introduction:** The objective of the paper is to create awareness among people about alternative and complimentary methods to control respiratory diseases and to lead a healthy life. According to WHO estimates (2007), currently about 300 million people have asthma and 210 millions people have chronic obstructive pulmonary disease (COPD) while millions have allergic rhinitis and others often-under diagnosed chronic respiratory diseases. These diseases cause structural and functional changes in the airways (remodeled). The mechanics of respiration get affected leading to mismatches between ventilation and perfusion and may also increase alveolar dead space resulting in hypercapnia, hypoxia and hypoxemia. They may become a life long challenge for some. The severity of the problems is interrelated with environmental fluctuations.

I am now 75 years old and as a patient of asthma, devised exercises by which the problems can be brought under control within minutes. The exercises pertain to cleaning of upper airway passages of the mouth, nose, pharynx, the primary sites of colonization of pathogens and sinuses, the way stations to the brain from excess mucus. The diseases cause the following changes in Airways.

1) **Inflammation:** is a physiological process. It plays the role of immunological defense against infection, injury or allergy. It is one mechanism, the body uses to protect itself from invasion by foreign organisms and to repair tissue trauma.

2) **Hyper secretion of mucus:** is a major pathological feature of diseases. It is the result of goblet cell hyperplasia in respiratory mucosa and is a prominent feature of inflammation. Chronic mucus hyper secretion is a potential risk factor for an accelerated loss of lung function. It increases risk of hospital admission as a result of lower respiratory tract infections. Its viscosity causes extensive ciliary’s damage and impairs mucus clearance.

3) **Bronco spasm:** is an additional factor particularly in asthma patients in whom the airways are hyper reactive. It is caused as a result of irritation or trauma of smooth muscles around them. With inflammation, bronco spasm and the excess mucus secretions retained in airways, the patency of
airways gets reduced. The airflow slows down towards the periphery of the bronchial tree to end as diffusion. As a result of the changes, asthma patients suffer from breathlessness.

According to Dr. Sarah Herrick, a research fellow, Dr. Robin Gore, a consultant in respiratory medicine and research fellow and Dr. David Thornton, a senior lecturer in the Faculty of Life Sciences at Manchester University who were conducting research (2008 – 2011) as a team into the factor of hyper-secretion of mucus, an abnormal production of mucus in the airways is a major contributor to the pathology of asthma as well as other debilitating respiratory conditions, such as cystic fibrosis and chronic pulmonary obstructive disease. They opined that, no mucus-directed therapies are available for asthmatics and the factors that lead to excessive mucus secretion during both chronic and severe asthma are not understood (2). The researchers further state that chronic alterations to the mucus-producing capacity of the asthmatic airways occur as a part of the spectrum of histopathological changes known as airway wall remodeling. The features of airway wall remodeling as a result of mesenchymal interactions have not been investigated in relation to goblet cell hyperplasia (excessive proliferation of cells) and mucus hyper secretion.

It appears, even now there is dearth of therapies.

In the circumstances, clearance of excess mucus becomes an extremely important factor for airway integrity.

Methods Exercises are therapeutic tools and are a potent medication in history. They are mucokineses and a recipe for healthy ageing. They reduce C-reactive protein resulting in reduced inflammation. Exercises strengthen the remodeled airways and reset the biological ageing process. There is no substitute for exercise.

Dr. William Joel Meges, M.D., Ph. D., Professor and Chief of the Division of Toxicology Brody School of Medicine at East Carolina University and Ms. Carol Svec, a fellow researcher, stated in their book, The Inflammation Cure, “If we could bottle the benefit of exercise, it would be the most potent medication in history. People who exercise have fewer physical disabilities and they seem to delay ageing disability by about 15 years(3).” A host of studies proved that exercise protects against chronic disease, extends life, and leads to a better quality of life as we age. According to them, the latest discovery is that exercise lowers levels of the inflammation marker (CRP), C Reactive Protein in the blood. Thus exercise reduces inflammation in the body. There is no age limit to the benefits of exercise. People can start exercising at any age and can continue exercising throughout life. The earlier you start, the better off you will be, but people who do not begin exercising until age 75 can still expect to see some increases in life-expectancy. Strenuous exercises on the other hand, can be harmful and suppress immune functions. Both aerobic and strengthening exercises have been shown to decrease levels of inflammation. Ideally both should
be part of your weekly routine. One should have a doctor’s approval before starting any intense regimen (3).

The following are the exercises that were devised by me besides physical exercises which helped me remove excess mucus from respiratory passages.

a) Upper airway passages mouth, nose, pharynx and the sinuses cleaning exercises b) Bronchial airways cleaning exercises and c) physical, aerobic and yogic exercises.

Upper Airway passages cleaning Exercises:

These exercises should be practiced with hypertonic solution i.e., a solution having greater osmotic pressure than that of cells or body fluids and draws water out of cells thus inducing plasmolysis. A glass of warm water mixed with a little sodium chloride (common salt crystals) NaCl will meet the purpose. The solution should be warmer than that of body temperature i.e., 37.00 degrees Celsius. Better results can be achieved if the patients use the solution having the temperature of 40.00 to 41.00 degrees Celsius.

The concept is based on “Living cells are osmotic systems and will shrink in hypertonic solutions (high salt concentration than in cell organelles) and swell and can burst in hypotonic solutions( pure water or low salt concentration).

This concept is useful, because the nasal mucosa is lined with permeable membrane bound in it by the cell organelles. During Inflammatory process the cells get filled with water, secretions enzymes etc. Osmotic pressure varies with concentration of the solution and with temperature increase.

Exercises:
1. Take a glass of hypertonic solution, keep it at the entrance of nasal passages, bend the body forward to about 70 to 80 degrees, slowly snort in the solvent, it goes in through the nostrils, up through the nasal passages, down in throat (pharynx) from where it takes a ‘U’ turn, enters the oral cavity and collects in the mouth, spit it out. Blow out the nose forcefully, the excess mucus collected in nasal lining gets drained out.

2. Take the solvent, bend the body forward as stated and keep it at the entrance of the nasal passages (ala nasi), breathe out forcefully through mouth till the lungs become empty from maximum air, then slowly snort in the solvent, it goes in through the nostrils, up through the deep
cone shaped tortuous nasal passages affecting all the turbinates (inferior, middle and superior) on the lateral sides of the nose, down in the throat (pharynx) from where it takes a ‘U’ turn, enters the oral cavity and collects in the mouth. Spit it out. Blow out forcefully, the excess mucus collected in the nasal lining get drained out.

3. Take hypertonic solution sufficiently into mouth, keep it wide open, bend the head backward till the trachea gets stretched and see the solvent touches the oro/naso pharynx, gargle for a few seconds and try to push out the solvent through nasal passages. During the said process, the whole of nasal lining particularly the sinuses, the lachrymal and ear (Eustachian tube ) duct openings into the turbinate’s get cleaned. During inflammatory conditions, the tortuous turbinates get hypertrophied and may result in nasal blocks. In the circumstances, the exercises should be practiced slowly.

While doing the first two exercises, there is no possibility for the solvent to reach the glottis as the body is in a forward bending position and while practicing the third exercise also there is no scope for the solvent to enter the lungs as the patient will be trying to gargle (expel the air from lungs) at oro/nasal pharynx level.

**Result of the exercises:**

1) The excess mucus produced by goblet cells and the other mucus producing glands in upper airway passages of mouth, nose, pharynx and the sinuses get cleaned.
2) And the hypotonic secretions in the mucosal cells get diffused towards hypertonic solution resulting in equal solute concentrations on two sides.

The inflammation of nasal mucosa gets reduced allowing free passage for air during respiration.

**BRONCHIAL AIRWAYS CLEANING EXERCISES:** It is important to know that the diaphragmatic muscle, the main breathing muscle of the respiratory system which makes an airtight separation between the abdominal and thoracic cavities play an important role while practicing these exercises. Application of a little pressure by the muscle on the lungs, either physical or aerobic, the excess mucus accumulated in bronchial airways moves up towards the nasal passages. It can be blown out easily. The exercises should be practiced with gravity assisted lobar positions. They are based on Expiratory Reserve volume of the patients and forced expiratory techniques.
Normal Respiration: During normal respiration (inhalation and exhalation), the movement of diaphragmatic muscle will be between 6\textsuperscript{th} and 5\textsuperscript{th} ribs, its origin being at 6\textsuperscript{th} ribs. During inhalation, diaphragm lowers to 6\textsuperscript{th} ribs and exhalation, it rises to 5\textsuperscript{th} ribs.

The ribs and the dome shaped skeletal diaphragmatic muscles play an important role in deep breathing and forced expiration. They help in expelling the mucus out of lungs. They are based on the concept:

"The deeper the inspiration, the lower the diaphragm descends i.e., beyond the 6\textsuperscript{th} ribs and greater the expiration the higher it rises i.e., higher than 5\textsuperscript{th} ribs.

The discension and ascension factors are important and play an important role in expulsion of mucus from lungs.

In a healthy person, the volume of air during normal inspiration or expiration is around 500 ml i.e., half a liter only

**INSPIRATED RESERVE VOLUME; means the volume of air we inspirit after normal inspiration**

*It will be in multiples of atmospheric pressure. Its volume depends upon the patient’s capacity to take deep breath. Best result can be achieved only when inspetred reserve volume is higher. The additional air during forced expiration builds up pressure and compresses the lungs and help in expulsion of mucus.*

On deep inspiration, the diaphragm descends below than normal i.e., 6\textsuperscript{th} ribs or beyond and creates a negative pressure inside the chest and as a result, the upper airway glottis opens creating a portal that connects the outside world to the respiratory system.

During forced expiration, the diaphragmatic muscle ascends higher than the normal limits i.e., higher than 5\textsuperscript{th} ribs or beyond and compresses the lungs resulting in expulsion of mucus.

**HIGHER THE DIAPHRAGMATIC MUSCLE RISES, GREATER WILL BE THE COMPRRESSION ON LUNGS AND BETTER WILL BE THE RESULTS**

According to medical reports in a normal healthy person, the inspiratory and expiratory reserve volumes are around 3000 ml and 1100 ml respectively. Women will have reduced volumes. They go on changing (1) When the lung tissue capacity declines and (2) when the pulmonary muscle power gets weakened. These two factors probably do not entirely result from aging process but
result more from the effects of sedentary life style as one grows older and also during chronic disease condition of the lungs.

The exercises are based on the concepts of:

a) “Take deep breath and hold “
b) “Breathe out as much air as possible through mouth so that the lungs become empty from air and hold breath”

Concept A): Take deep breath. On deep inspiration, the diaphragmatic muscle descends and lungs relax, hold breath for 20 to 25 seconds or a little more. Stretch hands up. Bend the body with stretched hands towards gravity assisted lobar positions. Press the stomach inside and breathe out forcefully through nasal passages. During sudden and forced expiration / exhalation internal intercostals and the diaphragmatic muscle with its convexity upward, ascend and compress the lungs. As a result of the generated abdominal and thoracic pressure, the excess mucus accumulated gets sheared off the walls of the airways and drain out.

Concept B): Breathe out maximum air through mouth slowly so that the lungs become empty from air. The diaphragmatic muscle passively ascends towards lungs. Hold breath for 20 to 25 seconds or a little more, stretch both hands up, bend the body towards gravity assisted lobar positions, then inspirate forcefully. On sudden and forced inspiration, the diaphragmatic muscle descends and then expirate/ exhale. On sudden and forced expiration through nasal passages, the abdominal, the internal intercostals and diaphragmatic muscle with its convexity upwards as stated in first exercise ascend forcefully and compress the lungs. As a result of generated abdominal and thoracic pressure, the excess mucus gets sheared off the walls of the airways and drain out.

**PHYSICAL, AEROBIC AND YOGIC EXERCISES:**
The physical exercises should mainly pertain to thoracic, diaphragmatic and abdominal muscles. The exercise regimen should be started after taking the advice of a qualified doctor.
They help in strengthening the inspiratory and expiratory muscles and make the airways flexible.

**Conclusion (Results):** Any mucus related respiratory health problem affects first the upper airway passages and then the tracheo bronchial tree as they constitute only one pathway. The respiratory tract cilia, the physiological barrier that prevents the entry of infectious agents becomes defunct when excess and sticky mucus forms. It is an innate protective mechanism, fails in its function. The exercises should be practiced first with upper airway passages cleaning exercises so that they become free from inflammation and excess mucus. Once they are cleaned, the defunct cilia
become active and ciliate mucus towards nasal passages and it can be blown out easily. Severe asthma and other patients, in whom the airways get narrowed as a result of bronchospasm, need assistance of salbutamol dilator to dilate the airways as the narrowed airways hold the mucus tightly. The bronchial airways cleaning exercises help in draining out total mucus from airways. The respiratory and the other diseases originating from its pathway come under control. Healthy ageing process commences.

*THE EXERCISES ARE BASED ON THE CONCEPT “ONCE THE OFFENDING FACTOR, THE EXCESS MUCUS, IS REMOVED OR DRAINED OUT, THE ORIGIN OF IT, INFLAMMATION GETS RESOLVED”*

**References**


