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## Original Article

# Therapeutic Enhanced Swallowing Mode may be a New Way to Effectively Remove Pathogens in the Throat - 6

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## ABSTRACT

**Background:** In daily life, when we have a cough and other cold symptoms, we habitually try to prevent further progress by drinking water, but sometimes it is effective and sometimes ineffective. I think the reason this traditional method of self-prevention and treatment works maybe that drinking water occasionally cleans the hidden parts of the throat. Obviously, the enhanced swallowing mode can ensure a more perfect cleaning effect, thus preventing the further invasion of pathogens into the respiratory tract.

**Methods:** Based on the review of the experience of four members of a family in the new mode of water swallowing operation and its significant control effect on throat symptoms, the possible mechanism of its prevention and treatment of respiratory tract infection was reasoned.

**Results:** After a year and a half of follow-up observation, it was found that all the subjects blocked the development of symptoms in time and effectively after the new swallowing water mode was used to deal with the initial symptoms of suspected throat infection such as pharyngeal pruritus and cough.

**Conclusion:** The new enhanced water swallowing mode can effectively prevent and treat throat irritable cough, and it is expected to become an autonomous treatment mode for people to effectively remove pathogens in the throat and prevent further progress of respiratory inflammation.

**Keywords:** Swallowing; Throat; Pharyngeal pruritus; Cough; Pathogens

## INTRODUCTION

When the upper respiratory tract infection such as pharyngolaryngitis occurs, the symptoms such as pharyngeal pruritus or cough often appear first, and further progress will be made to lower bronchitis or pneumonia. At this time, if these symptoms can be eliminated, it often means that the progress of the disease stops. Therefore, in the early stage of respiratory infection, in addition to fever symptoms, the presence or absence of pharyngeal pruritus or cough symptoms can often indicate the progress of the disease. Perhaps this is because the symptoms of the pharynx and larynx come from the stimulation and response of pathogens to the mucous membrane. If we can eliminate these symptoms, it means that the pathogen infection in the throat (pharynx and larynx) mucosa has been cleared, indicating that the progress of the disease has been stopped.

### The structural and functional characteristics of throat associated with pathogen invasion into respiratory tract

The pharynx is the common space for which air travels for breathing and food/liquid for sustenance. However, it is not a passive tube, but an active participant in airway protection [1]. Therefore, people can actively adjust the behavior of the pharynx to better protect the airway [2]. This can be achieved not only by preventing aspiration but also by more effective cleaning of food residues or pathogens at the junction of the pharynx and larynx.

The pathogens that cause respiratory diseases often invade through the mouth and nose, pharynx, larynx, trachea, and lower respiratory tract. But the mechanism by which pathogens reach the lower respiratory tract may vary. Viral pneumonia can occur by direct inhalation of viral particles into the lungs, or by continuous transmission of viral infection near the upper respiratory tract, or by hematogenous spread of distant viral infection. Another major route for pathogens to enter the lower respiratory tract is the aspiration of secretions from the oropharynx either directly or by reflux from the stomach [3-6].

Two important behaviors in airway protection are swallowing and cough [7]. These two functions can also be said to be the dual-functional barrier of airway protection. When the swallowing function fails to completely transport the material to the esophagus and the aspiration occurs at the airway entrance, the cough reflex

will become the next functional barrier to prevent a small amount of food or pathogenic particles that have been mistakenly inhaled into the upper part of the airway from further inhalation into the lower respiratory tract. Coughing is the last protective mechanism against aspiration, and its deficiency may make a swallow unsafe [8,9]. These two functions cooperate with airway protective structures - epiglottis, laryngeal vestibule, and glottis [10], playing a more effective role in airway protection. More effective swallowing and removal of material around the laryngeal inlet can prevent further coughing reflexes. In theory, we can infer that this applies not only to coughs caused by aspiration but also to coughs caused by pathogens. That is to say, when we effectively remove pathogens at the throat entrance through swallowing behavior, we can prevent further cough reflexes and lower respiratory tract infections such as pneumonia.

The conventional swallowing mode can only produce limited and mild swallowing pressure, which is a timely swallowing behavior. Normally, materials are allowed to pass over the laryngeal entrance after the epiglottis is completely closed [10,11]. These abilities are often only used in the ingestion and transportation of food, or the prevention of aspiration, but almost ignore its other important role - the cleaning of pathogens. Conventional swallowing mode may not be able to effectively remove pathogens adhering to the throat mucosa, because these respiratory susceptible pathogens may have adaptive ability to resist conventional swallowing force in long-term contact with the human body. Swallowing behavior may also have good cleaning potential for pathogen particles held in and around the laryngeal inlet, but it needs to change the conventional swallowing mode to achieve a more effective cleaning effect. For the first time, we propose a new enhanced swallowing water model.

It has been reported that drinking hot drinks can significantly alleviate the symptoms of cold and influenza through physiological and psychological effects [12]. We often try to reduce the symptoms of a cold by drinking water, but the traditional way of swallowing water alone cannot effectively wash away the pathogens adhering to the throat wall and cannot steadily improve the symptoms of pharyngeal pruritus and cough. We have not yet explored and utilized the potential for throat irrigation. In the early stage of pathogen infection in the throat, when there is discomfort in the throat, it may be able to prevent further lower respiratory tract infection by using effective throat washing as soon as possible.



### Specific steps of the new swallowing mode

The subjects were one family, including two adults and two children. In the early stage of suspected cold, flu, pharyngolaryngitis, and bronchitis, the subjects were instructed to carry out new enhanced swallowing water operations in case of cough or pharyngeal pruritus.

First of all, conventionally drink normal temperature water to moisten the throat. Then, with a small amount of water (3-8ml for an adult) in the mouth, hold breath, move the tongue slightly or change the head position to slowly push the water to the junction of the pharynx and larynx and pause slightly, then retracts the tongue base, elevate the larynx, and contract the pharynx under the state of holding breath, suddenly put pressure on the junction of the pharynx and larynx, and push the water from the oropharynx to the esophagus by strengthening the swallowing action. After 2-3 times of this operation, you will find that the pharyngeal pruritus disappear. The sound of obvious swallowing indicates the correctness of the operation.

### RESULT

In the past year and a half, four subjects had an intermittent cough, pharyngeal pruritus, runny nose, and other early symptoms of suspected cold about 2-4 times, but did not go to the hospital. All symptoms were relieved at that time or within one day after each new swallowing water mode prevention, without repeated cough, fever, and other symptoms. This method is safe and effective, which depends on the natural physiological function of the human body. The substances removed by the new swallowing pattern may be pathogens or other substances that induce coughing. In any case, the new swallowing model is an effective model to eliminate the stimulation factors and symptoms of the throat.

### Indications and contraindications

The above enhanced swallowing mode is only applicable to the initial stage of suspected throat pathogen infection when symptoms such as mild cough or pharyngeal pruritus are manifested. The new swallowing model is suitable for the prevention of bronchitis or pneumonia, or influenza, which are transmitted continuously through the throat infection route, or for the prevention of simple acute throat infection. However, it is not applicable when pathogen infection occurs through a non-respiratory pathway, and the patients who have progressed to severe lower bronchitis or pneumonia are also ineffective. The method may not be suitable for patients with other serious organic or functional diseases of the throat, to avoid the damage of the throat caused by frequent pressure washing. For children, it may affect the normal development of the throat, so it should not be a routine life habit. It is also necessary to treat the elderly with swallowing function decline with caution.

### Operation precautions

During operation, limit the amount of water swallowed to avoid mechanical damage. To use non-polluting warm water or normal temperature water, warm water may have a better cleaning effect. Ensure a small amount of liquid and breath-holding when swallowing to prevent aspiration. In addition, the new swallowing method is an artificial behavior of delayed swallowing reflexes, which will increase the risk of aspiration, so it can only be applied to people without swallowing dysfunction.

### DISCUSSION

When the occurrence of tracheitis or pharyngolaryngitis, people tend to cough, swallow, and other ways to remove pathogens and their secretions, or other substances trying to enter the lower respiratory tract. Although it can clear food residues, secretions, and other materials to a certain extent, it cannot clear pathogens well, and it will leave enough pathogens for reproduction and inflammation. Therefore, a stronger clearance mode is needed for pathogens to achieve a more efficient clearance effect, especially in the early stage when pathogens have not yet entered the lower respiratory tract and remain in the throat.

The cough reflex and swallowing function of the human body is adapted to the common events in daily life and evolved into its corresponding intensity, and for susceptible pathogens, it is inevitable to evolve the corresponding ability to parasitize the human body. Therefore, the adaptive ability of pathogens is often stronger than the comprehensive resistance of the human body under the condition of disease constitution. Therefore, it is easy to infer that in the early stage of the disease, the normal physiological exclusion ability of the human body to respiratory-susceptible pathogens is often weaker than the adaptive ability of pathogens. For example, the exclusion ability of conventional swallowing or cough reflexes to pathogens is often limited and lower than the invasive ability of pathogens, unless we strengthen these physiological exclusion functions.

### Conventional swallowing mechanism

The mechanism of swallowing involves reconfiguring the oropharynx from a respiratory tract to a swallowing (alimentary) pathway for a period of less than one second [13-15]. The pharynx can be viewed as a dynamic conduit with changing diameters. Contraction of the pharyngeal walls served to clear the tail of the material from the pharynx [16]. The pharyngeal movement is an active regulation behavior, which can regulate the pharyngeal pressure when swallowing.

The pharyngeal phase of a swallow is a patterned behavior. First, the tongue base retracts and then moves superior and posterior, which in turn directs the bolus toward the pharynx. During the tongue movement, there is the closure of the velopharyngeal port, which is conducive to the build-up of pressure in the pharynx and helps to propel the bolus toward the esophagus, and the contact of the soft palate with the back pharyngeal wall prevents the bolus from moving into the nasopharynx [1,17-19]. Then, the pharynx contracts to produce peristaltic waves, which promote the pharynx to clear the swallowing matter; then, the larynx is raised, the epiglottis is inclined, and the laryngeal inlet is closed, including the closure of the glottis and laryngeal vestibule, to prevent the material from entering the lower respiratory tract. Then, the anterior laryngeal movement causes the pressure of the upper esophageal sphincter to fall and the swallowing material is fed into the esophagus [1,10,15,19-27].

### Mechanism of the new swallowing pattern

The pharynx is an organ that can be actively regulated. During swallowing, people can enhance the closure and internal pressure of the pharyngeal cavity by regulating the pharyngeal contraction behavior [15]. At this time, it will produce a stronger liquid impact on the throat wall, which can effectively wash the pathogens in the throat mucosa into the esophagus and stomach.

Besides, in the new swallowing mode, the delayed swallowing



behavior will produce the epiglottis opening and glottis closing state when swallowing. This will increase the contact area, contact pressure, and flushing force between the swallowing liquid and the laryngeal inlet area, which is conducive to more effective cleaning of the laryngeal inlet area, including the usually concealed mucosal surface, such as the piriform recess, the inner and outer sides of the epiglottis, etc. The area around epiglottis may be the place where pathogens from the mouth and nose hold or hide. During the implementation of the new swallowing action, most pathogens may be removed due to the effective flushing of the liquid to the concealed area, because the pathogens have not yet been able to adapt to the strong liquid impact under the new swallowing mode.

Perhaps because of the glottic structure, it is easier to retain pathogens around the laryngeal inlet, epiglottis surface, and laryngeal vestibule. The lower part of the trachea and bronchus has a strong ability to repel pathogens. The cilia of the mucosal wall can catch pathogens and transport them to the throat for excretion [28]. Many people often need to clear their throats to effectively discharge the sputum at the laryngeal inlet, which suggests that the laryngeal inlet area may be an important place for pathogen retention and accumulation. So, often respiratory tract infection begins with throat symptoms. So as long as the pathogens around the laryngeal inlet are effectively eliminated by strengthening swallowing action, further progress of respiratory tract infection can be effectively prevented.

During normal swallowing, food deviation into the lateral food channel at the valleculae might work for airway protection. At this time, partial closure of glottic space and laryngeal vestibule may protect the airway [10,29]. During the implementation of the new swallowing method, by deliberately delaying swallowing and slowly pushing a small amount of liquid to the laryngopharynx to pass through the lateral food channel at the valleculae, it may prevent the defensive closure of the epiglottis structure, and the epiglottis will remain open when the liquid reaches around the laryngopharynx entrance. Therefore, when the pharynx contracts, the liquid will clean the entrance tissues of the larynx, such as epiglottis and vestibule, which are not closed completely, and prevent the occurrence of aspiration.

During normal swallowing, the closure of the laryngeal vestibular space is described as compression from the bottom to the top, which can clear the vestibule or squeeze out bolus material that has penetrated the area to avoid aspiration below the vocal folds [15,30,31]. True and false vocal folds prevent material from entering the lower airways to prevent aspiration and promote the forceful discharge of material that has penetrated the laryngeal vestibule [15,29,32]. In the process of swallowing in a new way, this mechanism will also contribute to the strong discharge of flushing fluid that has already penetrated the laryngeal vestibule space, to wash the larynx vestibule more effectively.

Aspiration risks in dysphagia patients often come from delayed swallowing [8]. The early inflow of oral liquid and subsequent swallowing action can strengthen the pressure of the liquid; at this time, the upper esophageal sphincter is delayed to open relative to the swallowing liquid, and the oropharynx and nasopharynx can be closed in time, thus creates a more closed environment to increase the swallowing pressure in an instant. This can lead to aspiration in patients with dysphagia [8,27]. But under the condition of normal swallowing ability, if the new swallowing mode is used to delay swallowing in a planned way, it can effectively prevent aspiration due

to the timely and effective closure of the glottis. At this time, it can rely on the increased swallowing pressure to enhance the pressure and speed of liquid flushing, which will produce a more effective flushing effect on the laryngeal inlet area, which will be conducive to more efficient removal of related pathogens.

There are two cavities in the pharynx, the upper (valleculae sinus) and the lower (pyriform sinus), which serve as bilateral reservoirs for collecting materials. A pyriform sinus is a safe place to holding material that is expelled from the lower respiratory tract when coughing [1,33-35]. Accumulated material in the pyriform sinus is similar to bolus accumulation before/during the pharyngeal phase of swallow, mucus ejected from the lower airways by coughing could pool in the pyriform sinus [7]. Patients with accumulated saliva have a large amount of food residue in the pyriform sinus [2]. Saliva in the mouth plays an important role as a medium to carrying oral bacteria to the lower respiratory tract. Some studies have reported a close relationship between the presence of oropharyngeal secretions in the laryngeal vestibule and the possibility of aspiration of food or liquid. In healthy individuals, saliva aspiration can occur when they are sleeping or awake [2,36]. Therefore, pyriform sinus and laryngeal vestibule may retain food residues or secretions, which may also facilitate the colonization of pathogens in the laryngopharynx and further invasion of the lower respiratory tract. This suggests that the laryngeal entrance areas such as the pyriform sinus and laryngeal vestibule may be an important place for pathogen accumulation and reproduction, so it may be one of the important reasons for throat infection. Under the new swallowing mode, the hidden parts such as the pyriform sinus and laryngeal vestibule will be cleaned more effectively by swallowing liquid, which will be conducive to the prevention and treatment of respiratory inflammation.

## CONCLUSION

The new way of strengthening swallowing water can enhance the washing pressure and liquid fluidity of the water on the throat mucosa, and make the swallowing liquid contact the concealed part of the laryngeal entrance area more effectively, so it may be more effective to remove the retained pathogens in the throat, and can stably relieve the cough and other symptoms. However, this study is a new swallowing treatment for the symptoms of pharyngeal pruritus and cough caused by uncertain throat stimulation factors, so whether it will produce universal prevention and treatment effect for different stimulation types still needs further study.

The structures around the entrance of the larynx such as the pyriform sinus, laryngeal vestibule, and epiglottis may be the place where pathogens are easy to hide, which is an important way to further lead to laryngitis, bronchitis, and pneumonia. The effective elimination of pathogens in these areas is obviously one of the most important measures to prevent and treat these diseases. The new enhanced swallowing method has proved to be an effective way to remove pathogens in these hidden areas and is expected to become a routine measure for self-prevention and treatment of respiratory tract infection.

In this paper, we propose for the first time a new enhanced water swallowing mode and its mechanism for efficient throat cleaning. This may help to further prevent lower respiratory tract infection, and it may also have a good auxiliary effect on the prevention of pneumonia caused by influenza and new coronavirus pneumonia. But the specific scientific mechanism needs to be further verified and improved by dynamic MRI, laryngoscope, or other endoscopy equipment and



experiments. Besides, although people have gained rich knowledge of the human anatomical structure and even cellular structure, their understanding of the regular potential of the functional combination of these anatomical structures may be far beyond our current cognition.

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