

Prevention of Aspiration: Oral Care, Antibiotics, Others

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Abstract

Keywords

- ▶ swallowing defect
- ▶ monitoring of impaired consciousness
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- ▶ correction of defective swallowing
- ▶ dysphagia rehabilitation

Patients with aspiration pneumonia often develop this lung infection due to poor oral health or because the contents of the digestive tract or upper airway enter the lower airway traversing the larynx through different mechanisms. Prevention of this condition is directed at the mechanism by which it occurs. The elderly are the most likely to suffer from aspiration pneumonia, occasionally due to issues related to poor dental health, but more frequently due to abnormal swallowing, which may appear after a stroke, a functional impairment related to aging, or may be part of a specific disease such as Parkinson's disease or some other nervous system condition. People with dysphagia complicated by pneumonia have limited feeding and become debilitated, and aspiration pneumonia in these individuals has a high mortality rate at 90 days. Dietary modifications, assistance with feeding, use of postures that facilitate a normal deglutition, rehabilitation, and use of medications to improve swallowing defects are the tools of medicine to overcome the obstacles to swallowing normally and prevent the development of aspiration pneumonia and its consequences.

Aspiration pneumonia is an infectious process resulting from the aspiration of oropharyngeal contents containing pathogenic bacteria,¹ and it must be differentiated from aspiration pneumonitis, which is a condition characterized by chemical damage to the lungs due to the aspiration of gastric contents, leading to an inflammatory response. Aspiration pneumonia can be prevented by carrying out actions aimed at avoiding both aspiration and contamination of the lungs with pathogenic bacteria. Aspiration of small amounts of oropharyngeal secretions is normal in healthy individuals, particularly during sleep. These episodes generally do not lead to clinically significant events. Prevention of aspiration pneumonia essentially involves controlling the factors that predispose to aspiration and colonization of the contents of the upper and lower digestive tract and upper respiratory tract with po-

tentially pathogenic microorganisms, mainly due to swallowing disorders, of an anatomical or functional nature. Among patients admitted to the hospital with community-acquired pneumonia, 55 to 80% have an abnormal swallow.² This entails a higher risk of aspiration of the digestive tract and/or a weakness or complete defect of the cough reflex and is also influenced by the dental state, as a niche for pathogenic bacteria. These disorders are much more frequent in the elderly, who are more predisposed to infections and particularly pneumonia, which tends to be more serious and have a more tortuous evolution and is more difficult to prevent, with higher mortality due to the anatomical and physiological changes that their body experiences and the immunosenescence, regardless of the cause or mechanism of such pneumonia, facilitating the entry of bacteria.³

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Toward the end of this century, the life expectancy of the population will increase, while the birth rate will decrease, significantly favoring an increase in the frequency of aspiration pneumonia.^{2,4} By then, prevention of this pneumonia will be much more in demand.

Once aspiration pneumonia is present in defenseless lungs, the only thing left to do is to prescribe antimicrobial treatment, which only solves part of the problem. As with other diseases, prevention is a priority, and it is not always easy. Aspiration pneumonia accounts for 5% of pneumonias that occur in patients under 30 years of age, 10% in those over that age, and between 18 and 30% in residents of nursing homes.^{2,5–7} Moreover, it is estimated that almost 15% of community-acquired pneumonia are aspiration pneumonias.^{6,8} Community-acquired pneumonia occurs more frequently in older patients with multiple comorbidities and is associated with a poorer prognosis and higher mortality rates.⁹ Aspiration elevates morbidity and mortality rates, subsequently increasing health care costs. Some reports indicate that individuals who experience aspiration episodes have an increased risk of mortality within 12 months.⁶

These aspiration pneumonias can be very difficult to treat and usually have a complicated course, which is why prophylaxis is essential to reduce its impact on health, seeking to prevent its development.

To discuss the different options for the prevention of this disease and to give a rational order to our analysis, we decided to divide the actions related to the prevention of aspiration pneumonia into oral and dental health, treatment of dysphagia, medical prevention measures, management of dysphagia in older persons, aspiration prevention in tube feeding, and aspiration prevention surgery, as summarized in ►Table 1.

Oral and Dental Health

Poor oral health is a significant factor in the pathogenesis of aspiration pneumonia, as evidenced in cases of ventilator-associated pneumonia. Studies have shown that identifying and addressing factors such as oral health, particularly in nursing home residents, can lead to a reduction in the incidence of aspiration pneumonia.¹⁰

Several factors contribute to the risk of developing aspiration pneumonia among residents of nursing facilities. Older people have more dental caries and gingival disease, and notably, inadequate dental care, as evidenced by a study showing that only 10.3% of residents accessed specialized dental services. Furthermore, nursing care is often suboptimal due to a low professional-to-patient ratio, limiting the time and availability of care for each resident. Additionally, nurses in these facilities frequently lack adequate training in the prevention of aspiration pneumonia, in contrast to those working in the intensive care units.¹¹

Validated tools exist for the assessment of oral health in older adults. The Revised Oral Assessment Guide (ROAG),⁹ developed and validated by Andersson et al, is particularly valuable for health care professionals, including nurses and caregivers.¹² It facilitates the early detection of oral health issues in institutionalized older adults and supports the implementation of targeted preventive interventions. The ROAG (►Table 2) includes a comprehensive assessment of anatomical structures such as the lips, mucous membranes, tongue, gums, teeth, and dentures, with dentures requiring removal for inspection. It also evaluates functional aspects, including saliva production, phonation, and swallowing. Each of these parameters is assessed and categorized using a numerical scale: one point for minor deviations, two points for moderate abnormalities, and three points for severe

Table 1 Prevention of aspiration pneumonia

Oral care: in hospitalized or institutionalized patients, this should include brushing the teeth, palate, and tongue with a soft brush and low-foaming toothpaste at least twice a day.
Oral cavity examination: dental status, infections, and food residues. From hospital admission and at least weekly in institutionalized high-risk patients.
Patients with swallowing disorders: should be referred early for evaluation by a speech therapist.
Foods and drinks with thickeners at different temperatures: may be useful in high-risk patients.
The order of nothing by mouth in high-risk patients will be temporary and will be a starting point to try to restore swallowing as soon as possible.
Naso-enteral tube feeding: indicated for patients with a recent diagnosis of swallowing disorder who cannot resume oral feeding within 3 days to preserve their nutritional status while an attempt is made to restore oral feeding.
Percutaneous endoscopic gastrostomy: this is reserved for high-risk patients who are unable to restore oral nutrition and have poor tolerance to naso-enteral tubes without achieving nutritional goals. It should not be considered permanent if oral nutrition is restored.
Others: Angiotensin-converting enzyme inhibitors, cilostazol, dopamine, etc. Benefits reported in studies in China and Japan, nowadays the current evidence does not allow generalizing these findings to other ethnic groups.
In patients at the end of life or with moderate–severe dementia: the discussion about the best interests of the patient should take place before indicating “nothing by mouth.”

Adapted from: Simpson AJ, Leigh Allen J, Chatwin M, et al. BTS clinical statement on aspiration pneumonia. Thorax 2023;78:3–21.

Table 2 Revised Oral Assessment Guide, ROAG

Category	Method	Numerical and descriptive rating			Procedures
		1	2	3	
Voice	Converse with the patient	Normal	Deep or rasping	Difficulty talking or painful	Consult physician
Lips	Observe	Smooth and pink	Dry or cracked, and/or angular cheilitis	Ulcerated or bleeding	Consult physician or dentist
Mucous membranes—dentures removed	Observe Use light and mouth. Mirror	Pink and moist	Dry and/or change in color, red, blue-red, or white	Very red, or thick, white coating. Blisters or ulceration with or without bleeding	Consult physician or dentist
Tongue	Observe Use light and mouth mirror	Pink, moist, and papillae present	Dry, no papillae present or change in color, red or white	Very thick white coating. Blisters or ulceration	Consult physician. or dentist
Gums	Observe Use light and mouth mirror	Pink and firm	Edematous and/or red	Bleeding easily under finger pressure	Support with oral care. Consult dentist or dental hygienist
Saliva	Slide a mouth mirror along the buccal mucosa	No friction between the mouth mirror and mucosa	Slightly increased friction, no tendency for the mirror to adhere the mucosa	Significantly increased friction, the mirror adhering or tending to adhere to the mucosa	Support with oral care. Artificial saliva substitute
Swallow	Ask the patient to swallow Observe Ask the patient	Normal swallow	Some pain or difficulty on swallowing	Unable to swallow	Consult physician

Source: Modified from Eilers et al⁵³ with permission from Nebraska Medical Center.

alterations. The guide also suggests appropriate interventions based on the findings, including recommendations for medical or dental consultations and specific dental care.¹³ Several studies suggest that poor oral health, as identified by the ROAG score, is associated with diminished performance in activities of daily living, sarcopenia, and malnutrition—each of which is a known risk factor for the development of aspiration pneumonia. Consequently, the ROAG score may serve as a valuable screening tool for identifying older adults at risk of aspiration.¹⁴

Evidence-based recommendations can be made to prevent aspiration pneumonia. However, most of these recommendations are derived from studies on the prevention of ventilator-associated pneumonia, where oral care is standardized and administered by professional nurses. These include maintaining daily oral hygiene using a soft toothbrush and fluoride-enhanced toothpaste, supplemented by dental floss. The incorporation of an oral rinse may also prove beneficial. Regular dental visits are advisable. Additionally, dentures should be thoroughly cleaned and removed during sleep.¹⁵ A Japanese trial demonstrated a reduction in the incidence of aspiration pneumonia among nursing home residents from 19 to 11% with enhanced oral care, including oral brushing after meals and weekly professional dental care.¹⁶ However, the evidence remains inconclusive, as some

studies suggest that the incidence of aspiration pneumonia does not significantly differ in institutionalized older adults receiving multimodal care for its prevention, including dental care and swallowing assistance. This inconsistency may be attributed to varying adherence levels among staff to the prescribed prevention measures, with adherence rates reported at 75% for oral brushing and 87.9% for the use of topical oral chlorhexidine.¹⁷

The factors contributing to the pathogenesis of aspiration pneumonia include poor oral health, swallowing disorders, colonization of the oropharynx by microorganisms, host susceptibility, and comorbidities. These factors are prevalent in the population, particularly among older adults. Therefore, implementing strategies that focus on improving oral health in this demographic can significantly reduce the incidence of respiratory infections. It is crucial to emphasize that these interventions should be complementary, and particular attention must be given to the training of health care professionals involved in the process.¹⁴

Treatment of Dysphagia

Prevention of aspiration pneumonia requires focusing on patients at risk for aspiration episodes, which particularly frequently include older adults with dysphagia. Dysphagia is

an alteration of swallowing; in fact, any mechanism that allows the contents of the upper respiratory or digestive tract to reach the respiratory tract entails an abnormality that could well be described as dysphagia. It can occur at any time in life but is predominant in older adults, especially those of more advanced age, and it affects up to 68% of adults living in nursing homes,⁷ and approximately 15% of noninstitutionalized older adults.^{18–20}

Dysphagia results from a complex interaction between swallowing disorders, mental status, age, and comorbidities. Patients who develop aspiration pneumonia due to dysphagia have problems swallowing and consequently eating normally, leading to malnutrition and dehydration. Unless dysphagia and its complications are too evident, it is necessary to confirm it with videofluoroscopic swallowing studies.¹⁷

This way of aspiration elevates morbidity and mortality rates, increasing health care costs. It has been reported that individuals who experience aspiration episodes have an increased risk of mortality within 12 months.²¹

Swallowing is a complex process involving six cranial nerves and several muscles,²² for this reason, the pathophysiological mechanism and the way to prevent dysphagia differ between different patients with a similar etiology. The normal swallowing process begins in the mouth, where the bolus is prepared until it is ready to be swallowed by mastication. In the oral cavity, the food is crushed and mixed with saliva, initiating the digestive process and giving shape and cohesion to the bolus. When the bolus acquires the characteristics that make it suitable for swallowing, it is transferred to the posterior zone of the oral cavity by means of the contraction of the soft palate and the posterior part of the tongue, ending at the root of the tongue and at the same time the entrance to the larynx closes by the epiglottis (closure of vocal cords, false vowels, and arytenoid cartilage) and finally, the bolus ends up entering from the pharynx to the upper portion of the esophagus. Once entered the digestive tract, the esophageal phase of the process is conducted by peristaltic movements that move the swallowed food through the esophagus by peristaltic contraction of the esophageal muscles.

Aspiration pneumonia due to dysphagia caused by a loss of functional connectivity within the neural swallowing network may be partially improved by neuroplasticity generated by the damaged hemisphere, allowing compensation for the motor impairment caused by the affected hemisphere. This process may allow recovery of swallow function within a few weeks after the stroke.²³ When an endotracheal tube is responsible for the pathogenesis of laryngeal-tracheal injury, as occurs in individuals undergoing invasive mechanical ventilation, neuromyopathy may appear, accompanied by a disorder in the sensitivity of the larynx in patients undergoing intubation and prolonged mechanical ventilation.^{24,25}

This dysphagia, which we must fight to avoid aspiration pneumonia, delays the return to oral feeding, complicates the patient's clinical course, and is even an independent predictor of mortality at 90 days.²⁶ Normally the epipharynx closes

the airway and the larynx rises, opening the upper esophageal sphincter and thus the bolus enters the epiglottic vallecula and the pyriform sinuses. Later, in the involuntary esophageal phase, peristaltic esophageal waves transport the bolus to the stomach.

In terms of rehabilitation to prevent the development of aspiration pneumonia, various strategies have been investigated. These include neuromuscular electrical stimulation to activate the gag reflex and reduce the risk of aspiration, as well as targeted rehabilitation of the pharyngeal and orofacial muscles. Other alternatives include cryotherapy, thermal tactile stimulation, and repetitive transcranial magnetic stimulation. Additional techniques involve tongue and mouth exercises, such as lip closure, neck muscle strengthening, and vocal cord adduction exercises. Collectively, these modalities have been demonstrated to enhance swallowing function and improve reflexes that protect the airway from aspiration, thereby reducing the risk of aspiration pneumonia.⁶

Medical Preventive Measures

Early recognition of high-risk patients and the development of a multidisciplinary team focusing on this issue are important in prevention. Interventions to reduce aspiration pneumonia risk can then be undertaken by a dysphagia team in patients breathing on their own. It is difficult to know the exact prevalence of dysphagia as a cause of aspiration pneumonia; there are conservative estimates suggesting that 15% of the elderly population are affected by dysphagia.²⁷

On the other hand, some researchers have shown that, in elderly patients, dysphagia and repeated aspiration favored by an impaired cough reflex increase the recurrence of aspiration pneumonia, worsening the sarcopenia already present in these patients. The impossibility of providing adequate nutrition favors the repetition of new episodes and greater sarcopenia with progressive deterioration of their immunity leading to a fatal outcome.²⁸

Several medical treatment measures are used to improve dysphagia of different etiologies and thus prevent the development of aspiration pneumonia and its consequences, including modification of diet, feeding assistance, appropriate posture or maneuver for swallowing, swallowing rehabilitation program, medication treatment, appropriate posture or maneuver for swallowing or drinking, and medication treatment and stimulation treatment.²⁹

Dietary Modification

This action usually involves the use of thickening agents to change the consistency of food and fluids. The different consistencies for the modified food were defined as: normal, soft, gratin/timbales, pureed, etc., and the thickened fluid as normal, chocolate milk, syrup, and jelly.³⁰ Chen et al in a scoping review concluded that texture-modified food and liquids reduced the risk of aspiration, and that this was helpful in maintaining adequate fluid intake for patients with dysphagia.³¹ Most of studies concluded that texture-

modified food and liquids reduced the risk of aspiration, and that this was helpful in maintaining adequate fluid intake for residents with dysphagia, but there exists little evidence supporting the use of texture-modified food to improve the clinical consequence of aspiration pneumonia.³²

Assistance for Feeding

Using appropriate skills and equipment to assist residents to have meals could reduce the risk of aspiration. There are few studies with sufficient data to make a recommendation about the use of certain feeding assistance practices. Perry et al analyzed the effects of therapeutic exercises, undertaken before, during, and/or immediately after head and neck surgery in patients with advanced head and neck cancer, on swallowing. Honey-thick liquids, which are more consistent with descriptors for “spoon thick” or “extremely thick” liquids, were analyzed.³³ Both showed a more positive impact on immediate elimination of aspiration during video fluoroscopy, but this consistency showed more adverse effects in a second follow-up study. During a second 3-month follow-up trial, there were a greater number of incidents of pneumonia in participants receiving honey-thick liquids than those receiving nectar-thick liquids or taking regular liquids with a chin-down posture.

Using Appropriate Postures or Maneuvers for Eating

Using appropriate postures or maneuvers could prevent aspiration when eating or drinking. Luk et al suggested in a study that nursing homes should have a quiet environment during mealtimes, without distractions at mealtime.²⁷ Additionally, it has been recommended that some environmental factors, such as lighting, should be considered.³⁴

Another aspect to consider is the temperature of the food. There are temperature-sensitive transient receptor potential (TRP) channels in the nerve terminals of the vagus and glossopharyngeal nerves. TRPV1 receptors are sensitive to high temperatures (>60°C) and TRPM8 receptors are sensitive to low temperatures (<17°C). Both extremes sharpen the swallowing reflex, so it would be desirable to provide food at different temperatures.³⁵

On the other hand, spices such as capsaicin acting on TRPV1 receptors stimulate the cough and swallowing reflex by increasing the release of substance P. Menthol is an agonist of TRPM8 receptors and has also shown improvement in the latency of the swallowing reflex, both with effects dependent on their concentration.^{36,37}

The olfactory pathway has also been explored to improve swallowing based on the finding that elderly people with recurrent episodes of aspiration pneumonia had reduced activity of the insular cortex.³⁸

Stimulation with piperine (derived from black pepper), a TRPV1 receptor agonist, improved swallowing, and odoriferous extracts from its peel stimulated the bilateral insular cortex through the olfactory pathway. Its utility was demonstrated in a randomized controlled trial in institutionalized patients by improving swallowing and blood flow in the

insular cortex on single-photon emission computed tomography.³⁹ Olfactory stimulation is a useful, simple, and inexpensive intervention that can be used independently of the digestive tract.

Program for Swallowing Rehabilitation

In terms of rehabilitation, various strategies have been investigated. These include neuromuscular electrical stimulation to activate the gag reflex and reduce the risk of aspiration, as well as targeted rehabilitation of the pharyngeal and orofacial muscles. Other alternatives include cryotherapy, thermal tactile stimulation, and repetitive transcranial magnetic stimulation. Additional techniques involve tongue and mouth exercises, such as lip closure, neck muscle strengthening, and vocal cord adduction exercises. Collectively, these modalities have been demonstrated to enhance swallowing function and improve reflexes that protect the airway from aspiration, thereby reducing the risk of aspiration pneumonia.³⁸

For a broad spectrum of muscle groups of the mouth and pharynx and to improve swallowing, speech and breathing during sleep, electrotherapy and transcutaneous neuromuscular stimulation³⁹ demonstrated their ability to improve swallowing in patients with stroke and dysphagia.^{40,41}

Medication Treatment Improving Swallowing

Several medications may improve the swallowing reflex by different routes, including amantadine, cilostazol, folate, angiotensin-converting enzyme inhibitors, and metoclopramide.²⁷

Amantadine was administered at a dose of 50 to 100 mg daily to 12 residents with swallowing problems. After 4 to 6 weeks of use, they could gradually tolerate food without aspiration.⁴² Cilostazol, a phosphodiesterase inhibitor, inhibits platelet aggregation and may increase dopamine and substance P concentrations in the brain, and potential serious complications like bleeding can occur.⁴³ Folate may lead to an impaired swallowing reflex when it is deficient. Since folic acid supplement has minimal side effects, it should be given to older patients with folate deficiency.²⁷ An angiotensin-converting enzyme inhibitor reduces the degradation of bradykinin and tachykinin, including substance P. Accumulation of substance P has a sensitizing effect on cough and swallowing reflex.⁴⁴ Metoclopramide can delay the development of pneumonia but has no effect on the frequency of pneumonia and the overall mortality in tube-feeding patients.^{45,46}

Avoid Drugs That Cause Aspiration

Some medications frequently used by older patients such as haloperidol, benzodiazepines, risperidone, or serotonin reuptake inhibitors show undesirable effects on consciousness.⁶ In addition, antipsychotics increase significantly the risk of aspiration pneumonia.⁴⁵ Moreover, extrapyramidal signs and dry mouth are frequent side effects of these medications and ones clearly associated with oropharyngeal dysphagia.^{47,48}

Management of Dysphagia in Older Persons

Dysphagia usually presents severe complications in the elderly. This, in addition to reducing the ability to eat normally due to the difficulties inherent to this disorder, also appears in parallel with the tendency to aspirate food content into the airway, instead of doing so through the esophagus. In this way, it is possible to find a patient who receives fewer nutrients in his digestive tract than expected and presents evidence of a lower respiratory tract infection. The presence of this type of dysphagia is found in 30 to 40% of the elderly who live independently,⁴⁹ 44% of those who must be hospitalized acutely and up to 60% of those who live in nursing homes.

Aspiration Prevention and Tube Feeding

Tube feeding is the way to feed people who cannot comply with their feeding, usually because they are critically ill, due to their state of consciousness, due to extreme weakness, or due to some type of multiorgan failure, regardless of the route by which they receive said feeding, it does not prevent aspiration pneumonia. Studies have established that tube feeding, whether administered via nasogastric tube or gastrostomy, does not prevent aspiration pneumonia. On the contrary, evidence suggests that tube feeding may increase the incidence or risk of related complications, although the findings remain inconclusive.¹¹ Patients receiving enteral nutrition have an increased risk of experiencing aspiration episodes, which can be as high as 40%.⁴⁹

An alternative for these patients is assisted hand feeding by caregivers. Creating an appropriate environment is also crucial, as studies have demonstrated that older adults often struggle to complete meals in noisy settings. Additionally, environments that are noisy and highly stimulating can increase the risk of delirium in this population.⁵⁰

The strategy of elevating the head of the bed 30 degrees during the tube feeding is usually practiced facilitating the reduction of the risk of regurgitation or food rising into the pharynx in the bedridden patient, but this does not provide any security regarding preventing the risk of aspiration. In practice, it is usually recommended to start feeding with low volumes and at a slow pace to avoid aspiration; however, this maneuver has not been shown to work, on the contrary, most of the studies in which this has been measured have not been able to demonstrate differences between feeding by this route continuously and those who receive it intermittently.⁵¹

The alternative of placing a feeding tube through a gastrostomy instead of a nasogastric tube did not lead to better outcomes.²⁷ The selection of the appropriate modality should be individualized according to the patient's specific needs, the clinical context, and the capabilities of the caregiving team.⁵⁰

Aspiration Prevention Surgery

The aspiration prevention surgery is classified in three different used approaches: removal of the larynx, altering the structure of the trachea, and closure of the larynx.⁵² The

aspiration prevention surgeries are performed to resolve aspiration and increase oral intake in 50 to 80% of patients. These interventions are intended for patients who suffer from aspiration pneumonia, do not respond to standard treatments, and do not have comorbidities or other reasons that make invasive approaches to resolve the problem inadvisable. Aspiration prevention surgeries improve the quality of life of patients and their caregivers by decreasing suctioning frequency.⁴⁷ Most patients lose vocal function after aspiration prevention surgeries; however, some patients who have undergone total laryngectomy or laryngotracheal separation restored their speech function through tracheoesophageal puncture and use of voice prosthesis.

Conclusion

Prevention of aspiration pneumonia requires attention to conditions that allow the entry of germ-contaminated contents from the upper airway and gastrointestinal tract into the respiratory tract. The most common mechanism is dysphagia, and the most common target is the elderly and other people with functional swallowing disorders. Preventive measures depend on the control of contamination of the oral cavity and the mechanism responsible for aspiration and, in the elderly, the collaboration of a sufficient number of professional nurses, specialists in physical rehabilitation, and speech and language therapy. The most serious and difficult-to-manage cases are mainly observed in diseases that affect neuromuscular functions in a chronic and progressive manner. The world's population will continue to age thanks to advances in medicine and increased life expectancy and this will increase the incidence of many of the conditions that are complicated by aspiration pneumonia. It is necessary to better understand the mechanisms that trigger the development of aspiration pneumonia to improve the health and preserve the lives of these patients.

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None declared.

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