An Overview of Presbyphagia

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Abstract
Dysphagia is a frequent problem in elderly population since it can cause aspiration that leads to more complications. It appears as one of major potential problemswhich cause disability in elderly. Degenerative process which causes changes in swallowing structures and physiology in healthy aging (presbyphagia)can affect the swallowing process and leads to dysphagia. Consequences of dysphagia vary from social isolation to life threatening conditionssuch as aspiration. Detecting presbyphagia is essential to prevent aspiration.
***Keywords**: Dysphagia, presbyphagia, aging process*

Deskripsi Singkat Presbifagia

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Abstrak
Disfagia merupakan masalah utama yang sering terjadi pada populasi lansia. Proses penuaan dapat mempengaruhi struktur dan fungsi organ menelan (presbifagia) yang dapat mengakibatkan disfagia. Area anatomi yang terlibat dalam proses menelan peliputi rongga mulut, faring, laring, dan esofagus.Konsekuensi yang timbul dari kesulitan menelan bervariasi, mulai dari isolasi sosial hingga kondisi yang lebih serius dan mengancam jiwa, seperti aspirasi. Mendeteksi presbifagia merupakan hal penting untuk mencegah aspirasi.
***Kata Kunci**: Disfagia, presbifagia, proses penuaan.*

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Background

Dysphagia appears as one of major problems potential to result to disability. Dysphagia typically refers to difficulty in eating as a result of disruption in the swallowing process.[1] Other frequently used term is the inability to move food from the mouth to the stomach.[2,3]including all of the behavioral, sensory and preliminary motor acts in preparation for the swallow, cognitive awareness of the upcoming eating situation, visual recognition of food, physiologic responses to the smell and the presence of food.[3]

Although dysphagia occurs in all age groups, from newborn to the elderly,[1]Older people represents the most affected group.[4] Estimates indicate that 15 to 40 % of individuals older than 60 years have dysphagia.[5] Over 50% of residents in long term care facilities have feeding difficulties, dysphagia, or both, and almost 30% of elderly people acutely admitted to hospital are dysphagic.[6,7]Healthy aging itself, affects the swallowing process (presbyphagia).[6]

This article will give an overview of normal swallowing process, aging process on swallowing process (presbyhagia) and strategy to prevent further complications.

Anatomic Structure

The anatomy areas involved in swallowing include the oral cavity, pharynx, larynx, and esophagus. Structure in oral cavity consists of lips anteriorly, teeth, hard palate, soft palate, uvula, mandible or lower jaw, floor of mouth, tongue and faucial arches. The pockets or cavities created by adjacent structures are usually where food or liquid collects and may remain after the swallow.[8] Musculature forming the floor of the mouth includes the mylohyoid, geniohyoid and anterior belly of digastric, all of which attach to the body of the mandible anteriorly and the body of the hyoid bone posteriorly. The hyoid bone forms the foundation for the tongue.[8]

The tongue is composed almost entirely of muscle fibers going in all directions. Functionally, the tongue can be divided into an oral portion and a pharyngeal portion. The oral tongue ends at the circumvallate papillae. The oral tongue which is active during speech and the oral stages of swallow is under cortical or voluntary neural control. The pharyngeal portion of the tongue (tongue base) begins at the circumvallate papillae and extends to the hyoid bone. It is under involuntary neural control coordinated in the brainstem (medullary swallow center), but can be placed under some degree of voluntary control.[8]

The roof of mouth is formed by the maxilla or hard palate, the velum or soft palate, and the uvula. The soft palate may be pulled down and forward against the back of the tongue by palatoglossus muscle in the anterior faucial arch or may be elevated and retracted to contribute to velopharyngeal closure by a combination of muscle pulls, including the palatopharyngeus located in the posterior faucial arch, the levator palatal muscle, and the fibers of the superior pharyngeal constrictor.[8]

The cell bodies of the preganglionic parasympathetic neurons supplying the salivary glands are located in the brain stem salivatory nuclei, which are divided into inferior and superior subdivisions based on the cranial nerve distribution of the axons supplying the salivatory glands. Neurons of the inferior salivatory nucleus (ISN) innervate parotid and lingual (von Ebner) glands via the glossopharyngeal nerve, whereas the superior salivatory nucleus (SSN) innervates the submandibular, and sublingual glands via the chorda tympani branch of the facial nerve.[9]The source of other central input to the salivatory nuclei is located in a large number of rostral brain areas including the parabrachial complex, Edinger-Westphal nucleus, mesencephalic nucleus, hypothalamus, substantia innominata, bed nucleus of the stria terminalis, and amygdala.[9]

Pharyngeal structures involved in deglutition include the three pharyngeal constrictors (superior, medial, and inferior) which form the posterior and lateral pharungeal walls. The muscle which is probably responsible for tongue base retraction and simultaneous anterior bulging of the posterior pharyngeal wall at the tongue base level is glossopharyngeus muscle. Cricopharyngeal muscle is another important structures in swallowing. Itprevents air from entering the esophagus during respiration.[8]The esophagus is a collapsed muscular tube approximately 23 to 25 cm long with a sphincter or valve at each end.: The upper esophageal sphincter (UES) at the top and the lower esophageal sphincter at the bottom.[8]

At the base of tongue, the pharynx opens into the larynx. The topmost structure of the larynx is the epiglottis. The wedge-shaped formed between the base of the tongue and the epiglottis is the valleculae. Together the valleculae and the two pyriform sinuses are known as the pharyngeal recesses or side pockets, into which food may fall and reside before or after the pharyngeal swallow.[8] The intrinsic structures of the larynx are aryepiglottic folds. Together, the epiglottis and aryepiglottic folds; the arytenoids, base of epiglottis, and the false vocal folds; and the true vocal folds form three levels of sphincter in the larynx preventing penetration of food or liquid during swallowing.[8]

Physiology of Swallowing

Swallowing is a process through which a food or liquid bolus is transported from the mouth through the pharynx and esophagus into the stomach.[1]Swallowing constitutes a complex sequential sensorimotor activity, with both volitional and reflexive components. Swallowing also simultaneously serves to protect the respiratory tract from aspiration and reflux events, and the digestive tract from potentially harmful compounds.[10]

Peripheral sensation, including two-point discrimination, vibrotactile detection, somesthetic sensitivity, proprioception, nociception, thermal sensitivity and chemical (taste) sensitivity,plays an important role in for swallowing.[10]

Human taste buds are located throughout the oral cavity in both lingual and extralingual locations, two-thirds of which are located in the tongue with the remaining third being located on the epiglottis, soft palate, larynx, and oropharynx. Three cranial nerves (VII, IX, and X) carry gustatory information away from the taste buds to the cortical taste areas via the nucleus of the tractus solitarius (NTS) and thalamus. Rolls et al found that orbitofrontal cortex is the cortical areas that receive information of taste.[10,11] Cortical areas receives information of taste response to taste stimulus.[12] Some of this information is also transmitted to the hypothalamus, which is an integral component for regulating feeding behavior.[1,13]

The neural control of swallowing is complex. It allows the safe and coordinated delivery of ingested food from the mouth to the esophagus while ensuring protection of the airway.[13] Swallowing and tongue elevation involved activity of the pericentral, anterior parietal cortex, anterior cingulate cortex, adjacent supplementary motor area, insula, cerebellum, and amygdala.[13,14,15] Tongue elevation activates a large volume of cortex.[15]

The sensory-motor relationship of swallowing have been shown by Che at al. Che et al reported that swallowing speed was decreased when the solution of quinine, glucose, citrus and saline was given, compared with water solution (neutral taste).[10] (see figure 1)

Recent study by Mistry et al found that taste can modulate central activity of swallowing. The study used transcranial magnetic stimulation (TMS) as intervention and pharyngeal motor-evoked potentials (PMEPs) which was recorded from an intraluminal catheter as a measure of corticobulbar excitability.[13] (see figure 2)

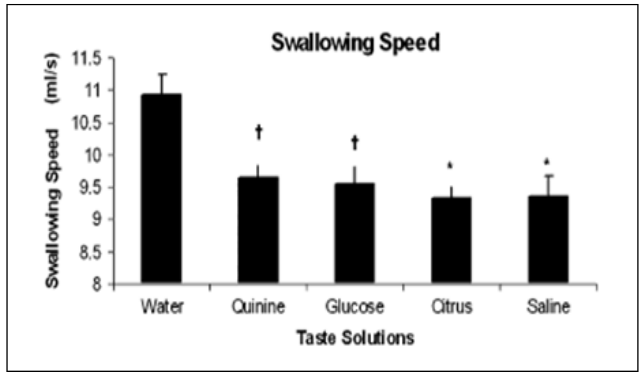

Figure 1. Swallowing Capacity in Relation with Taste.[10]

Oral Phase

Oral phase requires that a labial seal be maintained to prevent food from leaking from the mouth and a buccal musculature tension to prevent food from getting into the recess between the mandible and cheek.[2] This phase can be divided into 2 phase. The oral preparatory phase refers to voluntary processing of the bolus to render it swallowable, and the oral propulsive phase refers to the propelling of food from the oral cavity into the oropharynx.[1,2] Cerebral cortex controlled this process through the corticobulbar tracts and modulated by the taste, temperature, touch, and proprioception senses for formation of a bolus of the right size and consistency.[2] Recently, texture and hardness of the food has been found to modulate mastication process.[18]

Oral propulsive phase involves manipulation of the bolus formed in the preparatory stage in the central portion of the tongue and then pushing it toward the pharynx posteriorly

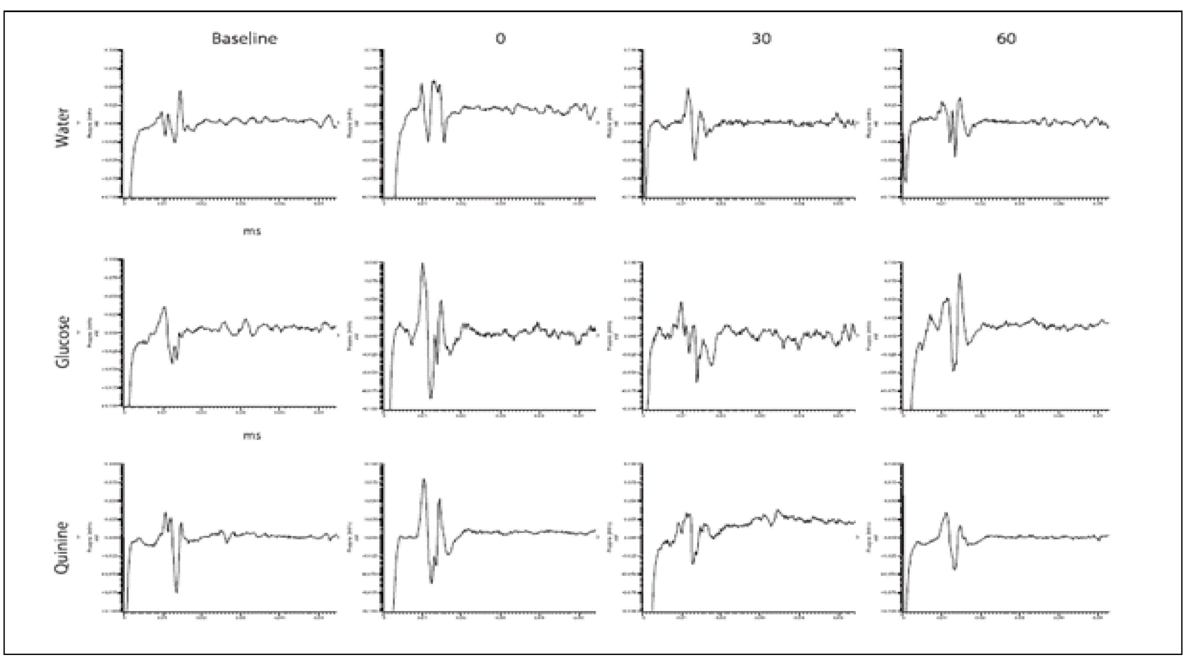

Figure 2. Cortically Evoked Electromyographic (EMG).[13]

Normal swallowing is divided into distinct phases: (1) oral, (2) pharyngeal, and (3) esophageal.[1,2,8,16,17] with a sequential anterior-to-posterior tongue elevation to trigger the pharyngeal reflex as the bolus enters the pharyngeal phase.[1]

The cerebellum controls output for the motor nuclei of cranial nerves V (trigeminal), VII (facial), and XII (hypoglossal). With single swallows of liquid, the entire sequence lasts about 1 second. For swallows of solid foods, a delay of 5-10 seconds may elapse while the bolus accumulates in the oropharynx.[1]

Pharyngeal Phase

The pharyngeal phase is of particular importance because, without intact laryngeal protective mechanisms, aspiration is most likely to occur during this phase.[1] This phase involves a rapid sequence of overlapping events that takes place in less than one second.[1,2]

There is a coordination between swallowing and breathing. When swallowing occur, there is a phase of apneic breathing (see figure 3). Harris et al found that the breathing pattern in swallowing process is expiration-expiration pattern (see figure 4). The pattern can be useful when the cough reflex or laryngeal sensation is reduced. Inhalation in swallowing process increases risk of aspiration.[19]

The pharyngeal phase of swallowing is involuntary and totally reflexive. This swallowing reflex involves the motor and sensory tracts from cranial nerves IX (glossopharyngeal) and X (vagus).[1]

Esophageal Phase

In the esophageal phase, the bolus is propelled downward by a peristaltic movement. The lower esophageal sphincter relaxes at initiation of the swallow, and this relaxation persists until the food bolus has been propelled into the stomach. Unlike the upper esophageal sphincter, the lower sphincter is not pulled open by extrinsic musculature. Rather, it closes after the bolus enters the stomach, thereby preventing gastroesophageal reflux.[1]

The medulla controls this involuntary swallowing reflex, although voluntary swallowing may be initiated by the cerebral cortex. An interval of 8-20 seconds may be required for contractions to drive the bolus into the stomach.[1]

Presbyphagia

Aging cause many changes in swallowing structures and physiology. The changes include masticatory performance, gustatoric performance, saliva production, oral phase of swallowing, pharyngeal phase of swallowing, and esophageal phase of swallowing.

In mouth, some teeth may be found missing.[20] Yet, high masticatory performance was maintained in aging population with complete, or almost complete dentition.[8,20] There may be also gum disease related with degenerative process. Both changes will affect food mastication process.[20,21] At elderly tongue, the taste bud quantity is reduced, especially for salty taste. [21] The reduced taste bud results in decreased rate of the intensity of taste and can affect interest of nutritious food.[8] There may be reduced saliva production. This causes further difficulty that is dry mouth (xerostomia).[22,23] It may cause burning or itching sensation of the oral mucosa and tongue, difficulties with speech and swallowing, eating difficulty and taste impairment. Difficulty wearing dentures and malnutrition have also been cited as problems that are related to dry mouth.[23] Saliva also lubricates and protects the mouth from microbial infections. Xerostomic patients can also be

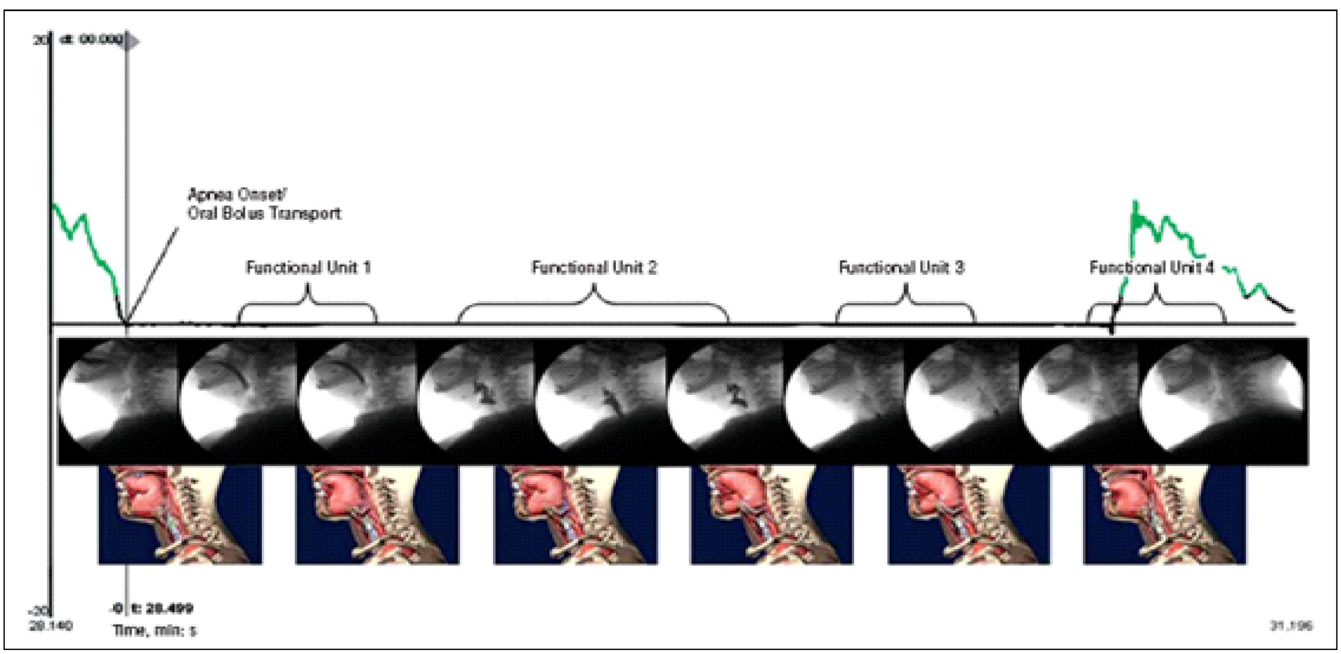

Figure 3. Apneic Onset when Swallowing Occur[19]

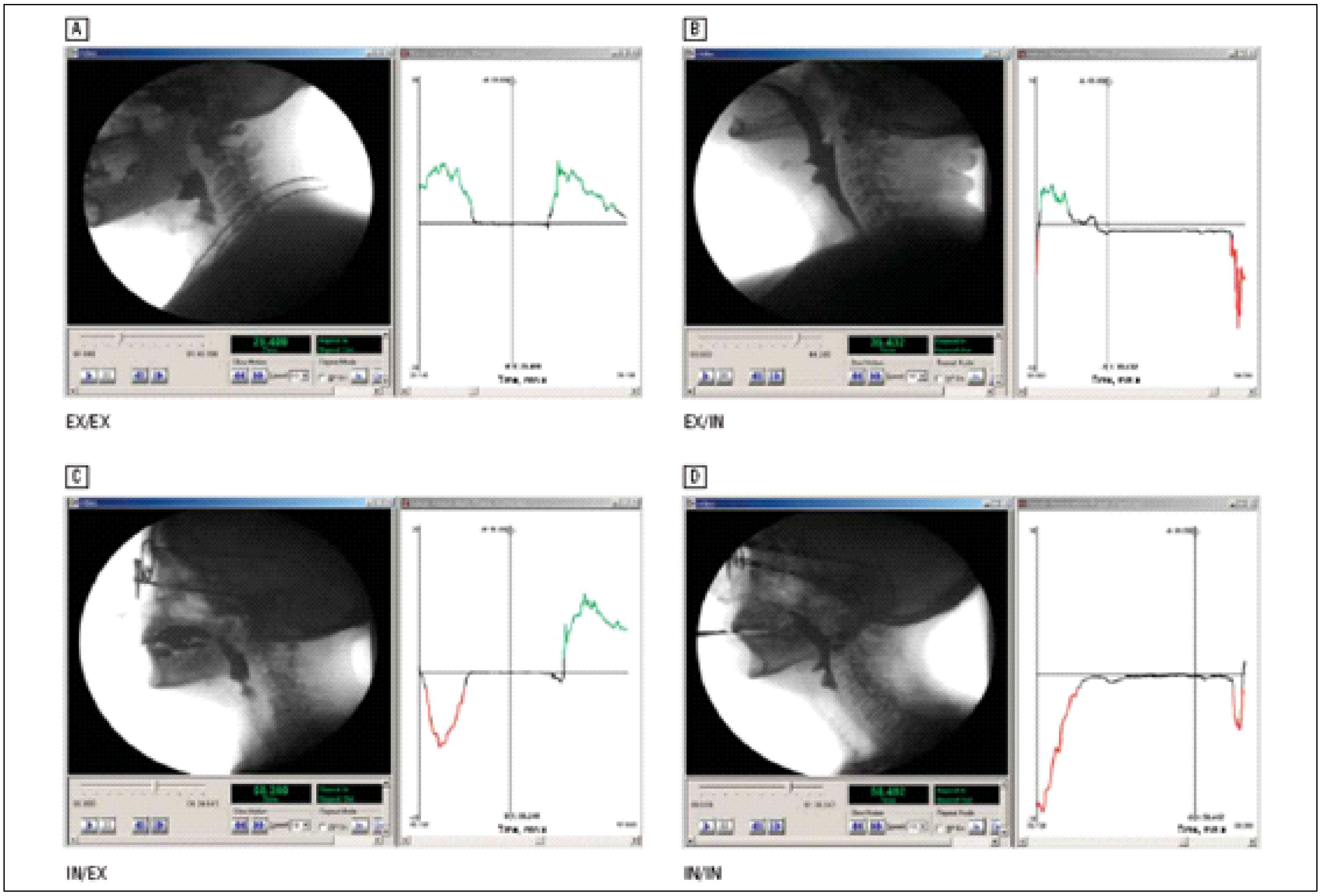

Figure 4. The Respiratory Pattern in Swallowing Process[19]

highly susceptible to the development of dental caries.[23]Based on these reasons, quality of life in those with xerostomia may be negatively affected.[22]

Some statistical changes of oral phase have also been noted. Besides the dipper swallow,[8] healthy older individuals have reduced isometric tongue pressures compared with younger individuals. Healthy older individuals manage to achieve the pressures necessary to affect a successful swallow because the peak lingual pressures are lower than those generated isometrically. As people get older, slower swallowing may allow time to recruit the necessary number of motor units required for pressures critical for adequate bolus propulsion through the oropharynx. Thus therapeutically speeding up an older swallow may result in less than sufficient swallow pressures and therefore may be contraindicated.[5]

A major characteristic of older healthy pharyngeal process is that it occurs more slowly. More time is required for initiation of the more automatic swallowing process.[5,8] This may be caused by underlying cervical arthritis which impinge on the pharyngeal wall, decreasing its flexibility.[8] Other factor is the hypotrophy of esophagus.[19] Thus, in older healthy adults the bolus may remain adjacent to an open airway by pooling or pocketing in the pharyngeal recesses longer than in younger adults.[5].

Penetration of material into the larynx vestibule is reported as increasing in frequency with age, but there is no increase in aspiration.[5,8] Using simultaneous videofluoroscopy and manometry (manofluoroscopy) and a tube through the nasopharynx similar in size, a significant interaction was found for tube by age. That is, liquid penetrated the airway significantly more frequent when the tube was in place only in the oldest group of men and women (older than 70 years). Thus it appears that under stressful conditions, older individuals are less able to compensate and are more at risk for aspiration.[5]

Aspiration may also be caused by the changes in elderly respiration and swallowing pattern. The normal and safest pattern of breathing during swallowing is expiration-expiration pattern. On the other hand, breathing pattern that usually can be seen in elderly population is inhalation-inhalation pattern.[19]

Central deterioration also plays an important role in prebysphagia. Magnetic resonance imaging (MRI) shows significant relationship between periventricular white-mater hyperintesities (PVHs) and slower swallowing. PVHs is found to occur and increase in older people.[5]

Changes in the periphery such as the changes in fiber density, muscle tension, muscle strength, and muscle contraction in facial, masticatory, and lingual musculature also occur with age and may be a function of changes in various sensory mechanisms or caused by muscle atrophy.[5]

Thus, the differences in the swallowing function between elderly and young individuals appear to be dependent on age-associated changes in both central nervous system (CNS) and peripheral mechanism. Progress in elucidating the biological basis of presbyphagia may have far-reaching significance for approaches to intervention in and prevention of age-related dysphagia.[5]

Evaluation

Examination should be started from vital status, respiratory status, until the swallowing function. After confirming the patient's nutritional status, the next step is to define whether the patient's problem is presbyphagia or dysphagia.During the physical examination, it is important to look for evidence of neurologic, respiratory and connective tissue disorders that may affect swallowing. To this end, an examination of oral-motor and laryngeal mechanisms is critical.[16,24]

Key clinical symptoms and signs of dysphagia, including coughing or choking on food, dyspnea, crepitations, and consolidation, should be sought.[24] If the patient determines that the difficulty is in bolus passage, begin to assess the pattern and severity of the symptom.[25]

The following questions will further elucidate the disorder:[25]

"Do you have any pain on swallowing?"

"Are there food or liquid consistencies that you have to forgo because they are likely to be more difficult to swallow?"

"Have you lost weight because of your swallowing difficulties?"

When appropriate, the clinical suspicion of aspiration by the physician should be followed up by bedside examination including bedside swallowing and supported by further swallowing tests when indicated.[24]The patient should be examined thoroughly. The anterior neck is inspected and palpated for masses. Dysphonia (abnormal voice) and dysarthria (abnormal speech articulation) are signs of motor dysfunction of the structures involved in oral and pharyngeal swallowing. The thyroid cartilage is gently mobilized by manual distraction to either side. Laryngeal elevation is evaluated by placing two fingers on the larynx and assessing movement during a volitional swallow.[16]

After excluding dysphagia, a thorough examination of feeding process should be done and assessed. The mastication function, including dentures, should be assessed. Oral hygiene should also be examined. Patient's complaint is an important tool to detect xerostomia.The gag reflex is elicited by stroking the pharyngeal mucosa with a cotton-tipped applicator or tongue depressor. A gag reflex can be elicited in most normal persons.[16]

The patient should also be observed during the act of swallowing. At a minimum, the patient should be watched while he or she drinks a few ounces of tap water. Drooling, delayed swallow initiation, coughing, throat clearing or a change in voice quality may indicate a problem. After the swallow, the patient should be observed for a minute or more to see if there is a delayed cough response.[16]

Swallowing function can be examined by swallowing trial including cervical auscultation by listening at the lateral aspect of the thyroid cartilage to the sounds of swallowing and respiration in order to detect aspiration (almost all normal people breathe out after a swallow); and if the facilitation adequate, bedside barium swallow.[26]Previous studies suggest cervical auscultation has predictive validity with a reported sensitivity between 90% and 73% and specfcity around 80%.[27]

Despite its minor limitations, the "modified barium swallow (MBS)" is still the best test to evaluate the oropharyngeal phase and the dynamic cause(s) of aspiration in older people.[24]MBS is necessary for patients with ventilator dependence when these individuals are being considered as candidates to begin oral feeding since aspiration in ventilator dependence patient is typically silent.[28]

Where the diagnosis of the cause of dysphagia remains unclear following the modified barium swallow, further specialist support may be required. Referral to a gastroenterologist for oesophageal dysphagia or to an ear nose throat specialist for oropharyngeal dysphagia may be required. Other tools to examine swallowing function is endoscopy i.e. fiberoptic endoscopic evaluation of swallowing (FEES).[24,29]It is indicated for elderly dysphagia patients.[30] The outcomes of endoscopic assessment may include evaluation of anatomy and swallow physiology, secretion management and sensation, airway protection as it relates to swallowing function, swallowing of foods/fluids, postures, strategies and manouvers, optimum delivery of bolus consistencies and sizes, therapeutic techniques.[30]

Management of Presbyphagia

Interventions for prebisphagia should bea multidisciplinary approach.Dentures problem should be managed in conjunction with dentist. If necessary, teeth prosthestic should not be delayed. Xerostomia can be managed by educating the patient to increase the drinking frequency. Saliva substitution can be a choice[23], andoral hygiene should be properly cared.[5]

Technique to increase oral sensory awareness can be used especially if the patients have swallow apraxia, tactile agnosia and reduced oral sensation. Sensory enhancement technique include increasing downward pressure of the spoon against the tongue when presenting food in the mouth, presenting a sour bolus, presenting a cold bolus, presenting a bolus requiring chewing, presenting larger bolus, and thermal tactile stimulation.[31] From the study by Ebihara, mint can also improve the sensitivity of elderly swallowing reflex.[32]

Postural adjustments are relatively simple. A general postural rule for fascilitating safe swallowing is to eat in the upright posture. If the pathophysiologic is the uncoupling of the oral from the pharyngeal phase of the swallow, a simple chin tuck (45°) reduces the speed of bolus passage.[5]

Other intervention is modifying food rate and amount. Eat slowly, don't rush or tired, concentrate on swallowing shoud be advised. Patient should take small amounts of food or liquid into the mouth and avoid mixing food and liquid in the same mouthful.[5]

Some exercises can be given. Yet, often rehabilitation exercises are withheld from dysphagic elderly patient because such a demanding activity is assumed to deplete any limit remaining swallowing reserve. These exercises include neck exercise and lingual resistance exercise.[5] If able, patient can be exercised to swallow the saliva.[31]

Most of elderly patient have numerous medications. These medications should be minimized especially if one affects swallowing physiology.Family support, especially in providing good mealtime atmosphere is required.[5]

Conclusion

Dysphagia is frequent and a major problem for elderly population. Naturally, elderly experience changes in their swallowing structures or physiology. Dysphagia in elderly is usually caused by diseases that worsened presbyphagia. Physical examination should be thoroughly made for elderly presbyphagic patient. After examining the vital status including nutrition status. Physiatrist should determine whether the problem is presbyphagia or dysphagia, since the risk and management could be highly different.Examination should be started from the structure that may have been affected by ageing process. Swallowing function should also be examined carefully.Some devices and technology can be used to examine swallowing function. FEES is one of the devices that usually used. For detects symptomless dysphagia, especially for elderly patient with mechanical ventilation who are candidate for oral feeding, MBS ischosen. Compensatory mechanism and oropharyngeal stimulation can be a benefit for these patients. Family and environmental support should also not be neglected.

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