Dysphagia in the Elderly

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Abstract: A ge-related neuromuscular dysfunction induces slowing of muscle movements. This is reflected in the swallowing process. Ingested bolus in the oral cavity may not be properly retained before the initiation of pharyngeal swallowing. Or the initiation of pharyngeal swallowing may be delayed, which often causes silent aspiration. The mortality of aspiration pneumonia is quite high in the elderly. Thus, oral hygiene is important for the prevention of silent aspiration. Cranial image findings often reveal cerebrovascular disease such as microinfarctions in elderly persons complaining of aspiration. Swallowing performance greatly varies in elderly persons. Biological age, not calendar age, should be considered in the diagnosis of elderly persons. Since the prevalence of dysphagia has been increasing with the surge of aging population, the etiology of dysphagia should be confirmed for proper treatment in individual patients.

Key words: Elderly population; Pharyngeal swallowing; Neuromuscular disorder; Aspiration

Introduction

Swallowing is a complex process that requires the coordinated actions of a large number of muscles and nerves. Pharyngeal swallowing (the transport of food from the pharynx to the esophagus) involves the swallowing reflex controlled by the deglutition center in the medulla oblongata. Thus, difficulty in swallowing in the elderly is often attributable to age-related central or peripheral nervous system impairment, or neurological damage associated with cerebrovascular or degenerative neuromuscular disease, which are common in the elderly.

Decline in physiological functions is generally observed in people over the age of 65 years. While the etiopathogenesis of dysphagia in young adults and the elderly cannot be clearly distinguished, close examination more often reveals organic disorders, such as mild cerebrovascular or degenerative neuromuscular disease, in elderly persons complaining of swallowing difficulty. The conditions may be asymptomatic, but they are frequently the cause of dysphagia.

Many elderly persons presenting with dysphagia are unaware of aspiration. When silent aspiration, often associated with vascular lesions in the basal ganglia, occurs repeatedly during...
sleeping, aspiration pneumonia may develop.\textsuperscript{1)}

This paper describes the pathogenesis of pharyngeal dysphagia in the elderly.

**Age-related Changes in Swallowing Functions**

1. **Mechanism of peripheral receptors\textsuperscript{2,3)**

   The propulsion of food into the pharynx stimulates the pharynx or pharyngeal mucosa, which in turn triggers the swallowing reflex. The pharyngeal mucosa contains numerous sensory nerve endings of the glossopharyngeal nerve and internal branch of the superior laryngeal nerve, in the form of free-nerve endings, beaded-nerve endings, and taste-bud structures. Although these nerve endings are believed to be concentrated in the posterior pharyngeal wall, our previous studies showed a wide distribution of the nerve-endings throughout the pharyngeal mucosa, with little variation in the density.

   Around the larynx, many free-nerve endings of sensory nerves are noted in the epiglottis. There are a number of nerve endings running longitudinally along the mucosal propria layer at the base of the laryngeal surface of the larynx; myelinated nerve bundles are also observed in the deeper layers of the mucosa. Immediately under the epithelium lies a distinctive nerve plexus formed of beaded nerve endings, and branch, probably originating from sensory nerves, in the form of free-nerve endings, reside in the subepithelium.

   A schematic depiction of peripheral receptors involved in the swallowing reflex is seen in Fig. 1. Such an elaborate structural network enables stimuli from a large area of the mucosa to be transmitted to the medulla oblongata. Although it has not yet been clarified as to whether all these nerve-endings are involved in the swallowing reflex, they apparently have functions as peripheral receptors for many protective reflexes, including the swallowing reflex. These nerve endings, slightly varying in their threshold for stimuli according to their location, are responsive to mechanical and chemical stimuli.

   How these peripheral receptors change with age still remains in the realm of speculation. Poor receptor response resulting from neurodegenerative disease or atrophy has been reported to lead to a decrease in the nerve conduction velocity.\textsuperscript{4} General degenerative changes in the nervous system may also affect the peripheral receptors. Furthermore, histological changes with age, including epithelial hyper trophy, metaplasia, and proliferative changes in the connective tissue, may also contribute to nerve receptor dysfunction in old age. Depressed pharyngeal reflex actions often cause slowing of swallowing in the elderly.

   We have often encountered elderly patients with reduced pharyngeal reflex and its associated slowing of swallowing movements in clinical settings.

2. **Role of the deglutition center\textsuperscript{2,3)**

1) **Sensory input from peripheral nerves**

   Peripheral sensory information is transmitted through the internal branch of the superior laryngeal nerve and the glossopharyngeal nerve to the solitary nucleus in the medulla. The binding site of synapse was partially projected into the medial and ventrolateral subnuclei, mainly the interstitial solitary subnucleus, and inputted for the formation of the subsequent swallowing reflex pattern. Furthermore, this sensory information is transmitted bilaterally through more synapses to the deglutition center in the
Type II neurons are interneurons that receive polysynaptic input from the sensory nerves. From these interneurons, information is further transmitted to Type III motor neuron nuclei, in which a swallowing pattern is generated. Type III neurons are motor neurons in the nucleus ambiguus and hypoglossal nerve nuclei, which drive the swallowing muscles to trigger a rapid sequence of the swallowing reflex in the pharyngeal stage of swallowing.

3) Control of swallowing and respiration

A series of protective reflexes inhibit respiration during swallowing. The laryngeal cavity closes to prevent entry of an ingested bolus into the airway. When this protective system fails, aspiration occurs. Respiration is also controlled during the swallowing process.

Swallowing is associated with a specific pattern of movement of the intrinsic and external laryngeal muscles, suggesting that a proportion of respiratory neurons recruited to the formation of the swallowing pattern may work to control respiration by linkage with the diaphragm and intercostal muscles. Such coordination may lower the subglottic pressure and facilitate the entry of an ingested bolus into the esophagus.
4) Role of the deglutition center in the cerebral cortex

It remains a challenge to identify the higher centers in the cerebral cortex in humans that regulate swallowing. Animal experiments have not been successful in clearly distinguishing between the deglutition center and the mastication center. There are still many issues that remain to be elucidated regarding the functions of the deglutition center.

We defined the area that the Type II neuron group directly projects on to in the cerebral cortex as the cortical deglutition area. The cortical deglutition area, which is observed bilaterally in the fronto-orbital gyrus, may exert promotive or inhibitory effects on the sequence of the swallowing reflex triggered by stimulation of the pharyngeal receptors.

5) Influence of aging on the neural mechanism controlling the deglutition center

How age-related changes in the nervous system affect swallowing remains unknown. Since the number of neurons in persons over the age of 80 years is believed to be decreased to 37% of that in younger adults, it is possible that impairment resulting from the decrease in the number of neurons may affect the mechanism of the central nervous system regulating swallowing functions.

3. Functions of peripheral effectors (swallowing muscles)

The numerous muscles involved in swallowing act in a specific coordinated pattern. During the swallowing process, the glottis closes as a result of sphincteric contraction of the intrinsic laryngeal muscle. At the same time, the pressures in the subglottic and interpleural regions also change.

Among the suprahypoid and inferiorhyoid muscles, the mylohyoid, geniohyoid and thyrohyoid muscles surrounding the larynx work in conjunction with the elevation of the larynx.

Among the pharyngeal constrictor muscles around the larynx, the hyo or middle pharyngeal constrictor muscle begins to contract in association with elevation of the larynx. Immediately thereafter, the thyropharyngeal muscle begins to contract. Subsequently, the descent of the larynx triggers activation of the cricopharyngeal muscle while the ingested bolus passes the pharyngo-esophageal junction.

The effects of aging on swallowing have been investigated using swallowing function tests. Radiographic studies have revealed that the position of the larynx during swallowing is relatively low in people over the age of 70 years, probably because of age-related decrease in muscular tone or deflection, which causes delayed laryngeal movement leading to aspiration. Such slight functional abnormalities and ill-timed movement may induce aspiration at the time of elevation of the larynx.

Swallowing efficiency varies in elderly persons. The epiglottis is sometimes found to tilt less during the swallowing process in people who have aspiration. Radiographic evaluation has revealed the presence of barium residue in the hypopharynx in persons over the age of 80 years, suggesting that peristaltic movements of the pharynx become weak with age. Decreased efficiency of peristaltic contractions has also been reported to prolong the esophageal transit time of food in the elderly.

Dysphagia Observed Frequently in the Elderly

1. Causes of dysphagia in the elderly

Although there are no causes of dysphagia specific to the elderly, multiple cardiovascular or neurological disorders are significantly more frequently associated in the elderly. In particular, cerebrovascular disease, artherosclerosis, and hypertension resulting from degenerative disease induce functional impairment of the central nervous system (CNS). Dysphagia attributable to degenerative neuromuscular disease refers to the abnormal transport of an ingested bolus due to poor neural regulation of the swallowing process. The causes of dysphagia...
2. Pathology of dysphagia

1) Corticobulbar tract disorders

The features of dysphagia associated with these disorders vary according to the site of the lesion. Cerebral cortical disorders cause spastic paralysis due to impairment of corticobulbar or corticopyramidal tracts, as well as dyscoordination or dystonia of muscles resulting from extrapyramidal disorders. In this group of disorders, the dysphagia is generally mild. Careful attention should be paid in these patients, because many are unaware of their condition. Silent aspiration, if left untreated, could be life-threatening.

Bilateral corticobulbar disorders may cause pseudobulbar paralysis. This group of disorders is associated with delayed initiation of contraction of the impaired muscles and a slower transport of the ingested bolus into the pharynx. The swallowing reflex is triggered only with difficulty, but, once triggered, the muscles act to produce a normal swallowing pattern. Thus, the pharyngeal transit time of the bolus is not synchronized with the swallowing muscle movements, and a part of the bolus does not pass the pharyngoesophageal junction, and is left in the hypopharynx. This residue enters the airway through the larynx after the end of the pharyngeal swallowing.

Extrapyramidal disorders cause muscular dyscoordination or dystonia, leading to a variety of impairments such as hypokinesia and hyperkinesia. A typical example of this disorder is Parkinson’s disease (PD). PD patients present with bradykinesia, but not many of them complain of swallowing difficulty. However, close examination reveals various types of mild swallowing impairment in these patients. PD affects the hypoglossal nerve nucleus, dorsal nucleus of the vagus, and the bulbar reticular formation, and the pathogenesis of dysphagia in these patients seems complex.

2) Brainstem disease

Brainstem disease is associated with impairment of the bulbar and spinal motor nerve nuclei, and is characterized by flaccid paralysis of muscles. Damage to the bulbar motor nuclei usually causes bulbar palsy associated with weakness or paralysis of the intrinsic and extrinsic laryngeal muscles. Dysphagia in patients with bulbar palsy is more severe than that in cases with pseudobulbar paralysis. Serious dys-

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Table 1  Classification of the Causes of Dysphagia Encountered Frequently in the Elderly

<table>
<thead>
<tr>
<th>Dynamic disorder (disturbance due to abnormality of the transportation movement)</th>
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<tbody>
<tr>
<td>1. Corticobulbar tract disorders</td>
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<tr>
<td>Bilateral pyramidal disorders — pseudobulbar palsy</td>
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<tr>
<td>Extrapyramidal disorders — hypokinetic movement disorders, hyperkinetic movement disorders</td>
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<td>Vascular disease: cerebral infarction, cerebral hemorrhage, etc.</td>
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<tr>
<td>Degenerative neuromuscular disease: amyotrophic lateral sclerosis, parkinsonism, Meige’s syndrome</td>
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<td>Poisoning: dyskinesia of the pharyngolarynx (mainly due to long-term treatment with antidepressants)</td>
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<tr>
<td>2. Brainstem disorders</td>
</tr>
<tr>
<td>Vascular disease: medullary infarction or hemorrhage, e.g., Wallenberg’s syndrome</td>
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<tr>
<td>(infarction of the region of the brain supplied by the posterior inferior cerebellar artery)</td>
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<tr>
<td>Degenerative neuromuscular disease: amyotrophic lateral sclerosis, spinal progressive muscular atrophy, etc.</td>
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<tr>
<td>3. Disorders of the peripheral nervous system</td>
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<td>Inflammatory disease: Guillain-Barre syndrome</td>
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<td>Metabolic disorders: diabetes mellitus, etc.</td>
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<tr>
<td>4. Neuromuscular junction disorders and myogenic disorder</td>
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<td>Myasthenia gravis, muscular dystrophy</td>
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</table>
Phagia is typically observed in patients with the lateral medullary syndrome, or Wallenberg’s syndrome, associated with infarction of the brain region supplied by the posterior inferior cerebellar artery. Bilateral bulbar palsy also causes aphasia and aphonia. Swallowing difficulty in patients with unilateral bulbar palsy is characterized by impairment of oral stage and pharyngeal transfer of the ingested bolus. Incomplete pharyngeal transit of the bolus due to decreased swallowing pressure may cause aspiration.

3) Disorders of the peripheral nervous system

Disorders of the cranial nerves IX, X, XI, and XII cause swallowing dysfunction. In many cases, cranial polyneuritis develops after viral upper respiratory tract infection. Isolated disease or combined disorder of the glossopharyngeal, vagal, and hypoglossal nerves is commonly associated with the development of dysphagia, but the prognosis is usually good.

4) Neuromuscular junction impairment and myogenic disorders

Diseases of the neuromuscular junction or the muscles per se include myasthenia gravis and muscular dystrophy. Paralytic or atrophic disorders of the muscles decrease the efficiency of muscular contraction and cause various swallowing disorders. Incomplete relaxation or contraction of the cricopharyngeal muscle severely obstructs the propulsion of an ingested bolus into the esophagus.

Conclusion

Age-related neuromuscular dysfunction induces slowing of muscle movements, which is also reflected in the swallowing process. An ingested bolus in the oral cavity may not be properly propelled before the initiation of pharyngeal swallowing; or the initiation of pharyngeal swallowing may be delayed, which often causes silent aspiration. The mortality of aspiration pneumonia is quite high in the elderly, and good oral hygiene must be ensured for the prevention of silent aspiration.

Cranial imaging often reveals the presence of cerebrovascular disease, such as microinfarctions, in elderly persons presenting with aspiration alone. The swallowing performance varies greatly among the elderly. The biological age, and not the calendar age, should be considered when examining elderly persons. Since the prevalence of dysphagia has increased with the surge in the aging population, the etiopathogenesis of dysphagia in the elderly must be clarified to ensure proper treatment of individual patients.

REFERENCES