Review

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Comprehensive assessment and treatment strategies for dysphagia in the elderly population: Current status and prospects

Xiqi Hu[1], Ya-nan Ma[2], Kenji Karako[3], Wei Tang[3,4], Peipei Song[4,*], Ying Xia[1,*]

[1] Department of Neurosurgery, Central South University, Xiangya School of Medicine Affiliated Haikou Hospital, Haikou, China;
[2] Department of Gastroenterology, Hainan General Hospital, Hainan Affiliated Hospital of Hainan Medical University, Haikou, China;
[3] Department of Surgery, Graduate School of Medicine, The University of Tokyo, Tokyo, Japan;
[4] National Center for Global Health and Medicine, Tokyo, Japan.

SUMMARY As the population ages, the prevalence of dysphagia among older adults is a growing concern. Age-related declines in physiological function, coupled with neurological disorders and structural changes in the pharynx associated with aging, can result in weakened tongue propulsion, a prolonged reaction time of the submental muscles, delayed closure of the laryngeal vestibule, and delayed opening of the upper esophageal sphincter (UES), increasing the risk of dysphagia. Dysphagia impacts the physical health of the elderly, leading to serious complications such as dehydration, aspiration pneumonia, malnutrition, and even life-threatening conditions, and it also detrimentally affects their psychological and social well-being. There is a significant correlation between frailty, sarcopenia, and dysphagia in the elderly population. Therefore, older adults should be screened for dysphagia to identify both frailty and sarcopenia. A reasonable diagnostic approach for dysphagia involves screening, clinical assessment, and instrumental diagnosis. In terms of treatment, multidisciplinary collaboration, rehabilitation training, and the utilization of new technologies are essential. Future research will continue to concentrate on these areas to enhance the diagnosis and treatment of dysphagia, with the ultimate aim of enhancing the quality of life of the elderly population.

Keywords dysphagia, aging, frailty, sarcopenia, rehabilitation, diagnosis

1. Introduction

Globally, aging has emerged as a prominent phenomenon in modern society, driven by advances in medical care and higher living standards (*1*). As of 2022, the population age 65 and older has surpassed 500 million worldwide, with projections indicating a rise to 1.2 billion by 2050. This trend underscores the pervasive challenge of aging faced by nations across the globe (*2*). As aging becoming more pronounced, the prevalence of chronic conditions among the elderly, including dysphagia, has increased (*3*). Despite its prevalence, dysphagia often remains overlooked, despite being a widespread health concern (*4*). Estimates suggest that 30% to 40% of the elderly population experience dysphagia (*5-7*).

Dysphagia manifests as abnormal difficulty or discomfort in the swallowing process, stemming from problems with the muscles and nervous system of the pharynx (*8*). It impacts dietary intake and nutritional status and also poses risks for various complications, including potentially life-threatening lung infections (*9*). In a cross-sectional study among elderly nursing home residents, those with dysphagia had a 6-month mortality rate of 24.7%, compared to 11.9% among those without dysphagia ($p < 0.001$) (*10*). In addition, dysphagia was found to be an independent risk factor for mortality in this population (*10*). As a result of the aging process, dysphagia is thus a significant health concern among the elderly, significantly affecting their quality of life and overall health status.

Therefore, obtaining a comprehensive understanding of dysphagia's current status, etiology, diagnostic approaches, and therapeutic interventions in aging populations is crucial to improving the well-being and health outcomes of older adults. The current work aims to provide an in-depth analysis and discussion of dysphagia in order to offer theoretical insights and practical recommendations to support future research endeavors and clinical interventions.

2. Current status of dysphagia in the context of aging

2.1. Pathophysiological characteristics of dysphagia in the aging population

Swallowing is a complex process involving coordinated interactions among various systems and tissues, including the central nervous system, sensory nerves, motor nerves, and peripheral receptors (*11*). In addition, the intact anatomical structure of the pharynx is crucial to proper swallowing. The normal swallowing process consists of four phases: oral preparatory, oral propulsive, pharyngeal, and esophageal (*7*). In the oral preparatory phase, an individual forms a homogeneous food bolus in the anterior part of the mouth. In the oral propulsive phase, the tongue applies pressure on the palate to propel the food through the upper esophageal sphincter (UES) with minimal resistance (*12*). Pharyngeal contractions primarily contribute to pharyngeal clearance (*12*). The pharyngeal phase entails a series of automatic, involuntary neuromuscular events initiated by the passage of gastric juices through the pharyngeal column, driven by the tongue. The soft palate ascends to close the nasopharynx, preventing regurgitation of food into the nasal cavity. The suprahyoid muscles elevate the hyoid bone and raise the larynx, and the epiglottis closes the entrance to the larynx. During the esophageal phase, the tongue's root contacts the pharyngeal wall while the hyoid bone moves forward, coinciding with the relaxation of the cricopharyngeal muscles and the opening of the UES. Involuntary esophageal peristalsis propels the homogeneous food bolus through the upper gastrointestinal tract and into the stomach.

In the elderly, alterations in the swallowing reflex can arise due to declining physiological function, nervous system diseases, and structural changes in the pharynx (*13*). These alterations encompass reduced tongue propulsive force, a prolonged response time of the submental muscles, delayed closure of the laryngeal vestibule, and delayed opening of the UES (*14*). Notably, delayed closure of the laryngeal vestibule and delayed opening of the UES are pivotal contributors to impaired swallowing particularly in the elderly. Decreased thrust force may lead to post-swallowing oropharyngeal food retention, potentially resulting in malnutrition, neuromuscular conditions, and sarcopenia according to several studies (*15-17*). Various factors, such as diminished oropharyngeal sensitivity, reduced neuron counts, and damage to the swallowing-related areas in the cerebral cortex or brainstem, may contribute to delayed swallowing, particularly prevalent in the elderly, prompting delayed swallowing maneuvers (*16,18,19*). Moreover, reduced sphincter opening in the elderly may signify decreased upper dental support and/or weakened food propulsion (*20*). Physiological apnea occurs during swallowing in healthy individuals (*21*), but older adults or those with concurrent nervous system diseases or chronic obstructive pulmonary disease may have increased swallowing frequency during the inspiratory phase, increasing the risk of aspiration linked to swallowing (*22*).

2.2. Prevalence of dysphagia in an aging population

As individuals age, systems in the elderly gradually fall out of balance and functionally decline, resulting in a decrease in neural and muscular functional reserve, which impacts swallowing function (*23*). In addition, as muscle strength, including that of the muscles of the larynx and oropharynx, diminishes over time, coordination and strength during swallowing are compromised, thereby increasing the risk of dysphagia (*24*). Decreased muscle mass have been identified as an independent risk factor for dysphagia (*25*). The risk of oropharyngeal dysphagia increases in individuals of advanced age with the increased incidence of frailty, muscle loss, and comorbidities (*26*). A study has indicated that frailty correlates with dysphagia and reduced quality of life, irrespective of age, the presence of dementia, or nutritional status (*27*). The prevalence of oropharyngeal dysphagia among independently living seniors (mean age: 78.2 years) was 27.2% (*28*). In healthy seniors, alterations in swallowing function do not signify pathology (*29*) (as shown in Table 1).

There is a significant correlation between decreased tongue strength and aspiration (*41*). Sarcopenia was observed in 45% of the elderly with concurrent dysphagia residing in nursing homes (*35*). Within geriatric outpatient clinics, 6.7% of patients over the age of 60 had dysphagia (*38*). Among elderly patients with concomitant frailty hospitalized in emergency departments, 47.4% had dysphagia (*42,43*).

As the elderly population continues to grow, there is a corresponding increase in the proportion of elderly individuals with combined neurological disorders (*1,8*), which increases the risk of developing dysphagia. Over the years, the prevalence of stroke surged by 102% from 1990 to 2019, with approximately 42% or more of stroke survivors experiencing dysphagia (*44,45*). In 2018, the global prevalence of Alzheimer's disease (AD) stood at 50 million, a figure projected to triple by 2050 (*46*). Roughly 80% of individuals with AD have dysphagia (*47*). A study conducted in the US revealed that Parkinson's disease was diagnosed in over 50% of individuals age 85 and over (*48*), with 60% of Parkinson's patients experiencing pharyngeal dysphagia (*7,47*). In addition, other neurological disorders such as traumatic brain injury and neurological tumors can also affect the neural control of the pharynx, consequently impacting swallowing (*49-51*). Moreover, oral health issues such as tooth loss and dry mouth, cervical and laryngeal tumors, and postoperative esophageal stenosis can exacerbate dysphagia (*52,53*). Alterations in oral function and oral sensorimotor function among older adults and those receiving long-term care in senior populations are linked to a higher prevalence of oropharyngeal dysphagia (*54*). Consequently, swallowing function in older adults typically declines

Table 1. Prevalence of dysphagia in different elderly populations

Author (Year) References	Study population	Age	Screening methods	Prevalence of dysphagia
Jones *et al.* (2023) (*30*)	Individuals residing in the community	> 65 years	Questionnaire (Self-reported dysphagia)	10.6%
Mello *et al.* (2022) (*31*)	Individuals residing in the community	> 60 years	Questionnaire	8.1%
Takeuchi *et al.* (2014) (*32*)	Individuals residing in the community	Average age: 80.7 years for men and 82.9 years for women	Questionnaire (DRACE)	13.3%
Serra-Prat *et al.* (2012) (*33*)	Individuals age 70 and over who are living alone	Average age: 78 years	Questionnaire (V-VST)	18.8%
Igarashi *et al.* (2019) (*34*)	Older individuals living alone	Average age: 75.0 years	Questionnaire (EAT-10)	25.1%
	Dependent elderly	Average age: 82.3 years	Questionnaire (EAT-10)	53.8%
Campo-Rivera *et al.* (2022) (*35*)	Nursing home residents	Average age: 84 years	V-VST	65%
Yuan *et al.* (2022) (*36*)	Nursing home residents	Average age: 84.28 years	WST	75.3%
Lin *et al.* (2002)(*37*)	Long-term care facility residents	Average age: 77.07 years	Questionnaire	51%
Bahat *et al.* (2019) (*38*)	Hospital geriatric outpatient clinic	Average age: 74.1 years	Questionnaire (EAT-10)	6.7%
Mateos-Nozal *et al.* (2020) (*39*)	Emergency geriatric ward	Average age: 93.5 years	V-VST	82.4%
Maeda *et al.* (2016) (*40*)	Hospitalized elderly	Average age: 82.5 years	FOIS	30.0%

Abbreviations: DRACE, Dysphagia Risk Assessment for the Community-dwelling Elderly; EAT-10, 10-item Eating Assessment Tool; FOIS, Functional Oral Intake Scale; V-VST, Volume-Viscosity Swallow Test; WST, Water Swallow Test.

with age, compounded by the presence of multiple chronic conditions common in the elderly population, such as stroke and geriatric diseases, thereby further increasing the prevalence of dysphagia.

2.3. Complications associated with dysphagia in elderly individuals

Dysphagia in the elderly impacts their physical health and also detrimentally affects their psychological and social well-being. This condition can lead to serious complications, such as dehydration, aspiration, aspiration pneumonia, and malnutrition, significantly increasing the complexity of their health status and posing life-threatening risks. More than 50% of elderly individuals in nursing homes experience dysphagia, with approximately 19.7% requiring nasal feeding tubes due to severe aspiration (*42*). Moreover, over 22% of elderly individuals with concurrent dysphagia suffer from malnutrition (*55*). Among stroke patients, dysphagia has been associated with a 1.7-fold higher in-hospital mortality rate compared to controls (95% CI 1.67-1.74). In addition, dysphagia is correlated with prolonged hospitalization, increased healthcare costs, and a higher likelihood of readmission to acute care facilities following discharge (*4*). Moreover, dysphagia has been identified as an independent risk factor for mortality among elderly nursing home residents (*10*). In patients with dementia, dysphagia is linked to increased rates of malnutrition, respiratory infections, and mortality (*47*). Hence, dysphagia impacts the physical health of individuals and also increases the risk of aspiration, exacerbates the severity of disease, and jeopardizes their safety and survival.

Moreover, dysphagia can exacerbate social and psychological burdens on patients, leading to psychological issues like anxiety and depression and diminishing their overall quality of life. A study found that 41% of dysphagia patients experience anxiety or panic during meals, and more than one-third avoid communal dining due to dysphagia-related concerns (*5*). Intermittent dysphagia is often linked to anxiety, whereas progressive dysphagia is primarily associated with depression (*56*). Studies have indicated that depression affects 7.2–49% of the elderly population (*57*) while anxiety disorders affect 3–14% (*58*). These psychological factors can further disrupt normal swallowing function and exacerbate dysphagia symptoms, perpetuating a vicious cycle. Complications stemming from dysphagia can lead to muscle frailty, decreased functionality, hospital admission, increased comorbidities, readmission, increased use of medication, and prolonged hospitalization (*59*). Consequently, dysphagia poses a significant socioeconomic burden, intensifying both the social and psychological strain on patients and placing substantial pressure on national healthcare budgets (*60*).

3. Screening and evaluation of dysphagia

3.1. Screening for frailty and sarcopenia in the elderly population

Frailty and sarcopenia are prevalent among elderly individuals and are closely linked to the onset of dysphagia. Therefore, comprehensive screening, including assessments for frailty and sarcopenia, is advisable in this demographic. Currently, widely utilized screening tools for frailty include the Clinical Frailty Scale (CFS) and the Comprehensive Geriatric Assessment (CGA) (*61*). A study has indicated that use of the CGA yielded favorable outcomes among hospitalized elderly patients, such as decreased mortality

and rehospitalization rates, along with enhanced physical functioning (*61*). The European Working Group on Sarcopenia in Older People (EWGSOP2) has proposed a clinical pathway for sarcopenia evaluation comprising four steps: find, assess, confirm, and severity. Initially, individuals are identified using the Strength, Assistance with walking, Rising from a chair, Climbing stairs, and Falls (SARC-F) questionnaire (*62*). Subsequently, they are assessed using the chair stand test. Afterwards, dual-energy X-ray absorptiometry (DXA) or bioelectrical impedance analysis (BIA) is used to verify muscle mass. Finally, somatic functional status is further evaluated (*63*).

3.2. Dysphagia screening

Screening for dysphagia is crucial in the elderly population due to its varied causes and often subtle clinical manifestations (*64*). Older adults at risk for dysphagia, including those who are frail, who have sarcopenia, who suffered a stroke, or who have neurodegenerative diseases or head and neck tumors, should undergo screening. This screening should be conducted by specialized clinicians or nurses using specific questionnaires and swallowing assessment tests.

Two widely used questionnaires are the Sydney Swallow Questionnaire (SSQ) and the 10-Item Eating Assessment Tool (EAT-10) (*65*). The SSQ is particularly effective at assessing the severity of dysphagia in patients with neuromuscular disorders (*66*). Both the SSQ and the EAT-10 are valuable for dysphagia assessment. The SSQ focuses on evaluating dysphagia severity in patients with neuromuscular conditions, while the EAT-10 demonstrates good sensitivity and specificity across various etiologies (*38,67*).

Common swallowing assessment tests include the Toronto Bedside Swallowing Screening Test (TOR-BSST), Volume-Viscosity Swallow Test (V-VST), Gugging Swallowing Screen (GUSS), and Standard Swallowing Assessment. The TOR-BSST and V-VST are validated tools for assessing dysphagia related to neurological disorders. The TOR-BSST is a risk screening tool for dysphagia that requires training to administer, boasting a sensitivity of 80–96% and a specificity of 64–68% (*68,69*). The V-VST is a dysphagia risk screening tool that involves up to nine swallows, utilizing three different viscosities and three different volumes. It screens for dysphagia risk and also offers guidance on oral intake. Its sensitivity ranges from 69% to 100%, and its specificity ranges from 29% to 87% (*70,71*). Patients testing positive on the swallowing assessment should undergo additional clinical evaluation and instrumental assessment to confirm the diagnosis and formulate an appropriate treatment plan.

3.3. Clinical assessment of swallowing function

The clinical assessment of swallowing function is pivotal for pinpointing the location and severity of dysphagia as well as determining the necessity for further diagnostic procedures and treatment (*52*). This assessment typically entails gathering a comprehensive medical history, conducting a physical examination, performing an oral motor examination, and administering swallowing assessment tests. When taking the patient's history, the assessor needs to inquire about any neurologic, psychiatric, head and neck, or upper gastrointestinal disorders, as well as the patient's nutritional status. An oral motor examination, overseen by an otolaryngologist and a speech-language pathologist, evaluates the structure and function of the jaw, tongue, pharynx, and larynx, along with the associated cranial nerves (V, VII, IX, and XII) (*70*). Given the correlation between dysphonia and swallowing function, assessing articulation is also essential (*72*). Moreover, absence of the cough reflex has been linked to silent malabsorption, and a simplified cough test may have some predictive value in dysphagia screening (*73*). Patients suspected of having dysphagia should undergo swallowing assessment tests such as the V-VST and the GUSS. Further instrumental assessment is recommended for patients testing positive on the swallowing assessment tests.

3.4. Instrumental assessment

Instrumental assessment serves as a crucial method for accurately evaluating the functional status of swallowing. This evaluation aids physicians in devising individualized treatment plans and monitoring treatment effectiveness to enhance the patient's quality of life. Ultrasonography offers a means to measure swallowing muscle mass and quality in elderly patients with sarcopenic dysphagia. It can identify specific factors indicative of sarcopenic dysphagia, such as lingual muscle area (sensitivity of 0.389, specificity of 0.947, and critical value of 1,536.0) and lingual root muscle area brightness (sensitivity of 0.806, specificity of 0.632, and critical value of 20.1) (*74*). Videofluoroscopy (VFS) and fiberoptic endoscopic evaluation of swallowing (FEES) are recognized as the gold standard for dysphagia assessment. VFS allows for monitoring of the anatomy and function of the oral cavity, pharynx, and larynx. It assesses the functionality of airway protective mechanisms by providing insights into the function of various anatomical structures (tongue-pharyngeal junction, pharyngeal junction, and epiglottis opening and closing times) (*75,76*). Despite its advantages, VFS is limited by its use of radiation and its predictive capability regarding aspiration pneumonia (*77,78*). In contrast, FEES, conducted at the bedside, enables precise visualization of mucosal surfaces and movements within the base of the tongue, pharynx, and larynx and it is well-tolerated by patients (*79*). Its utility extends to assessing dysphagia in the elderly and evaluating dysphagia associated with various conditions, including head and neck neoplasms, post-

stroke complications, and neurological disorders (*80-83*). Nevertheless, FEES is constrained by its inability to quantify physiological swallowing processes, relying instead on subjective interpretation of residual findings.

Swallowing electromyography (EMG) and high-resolution manometry (HRM) of the esophagus offer detailed insights into physiological function (*84,85*). These modalities assess muscular coordination and strength relevant to swallowing, alongside normalizing esophageal movements and pressure changes. Notably, they present advantages in diagnosing post-stroke dysphagia (PSD), providing more objective and sensitive assessments compared to clinical methods (*86*). For acute stroke scenarios, the use of standardized, validated, and reliable instruments in PSD assessment should consider various factors like the type of stroke, history, severity, diabetes, and sex to mitigate pneumonia risks and reduce mortality (*45*). Moreover, assessment of swallowing function through ultrasonography, functional magnetic resonance imaging (fMRI), and real-time MRI furnishes critical insights, capitalizing on advantages such as soft-tissue visualization, reliable timing analysis, and eliminating x-ray exposure (*87-89*). A comprehensive assessment incorporating these diverse tools and methods aids in diagnosing and devising treatment plans for patients with dysphagia (as shown in Figure 1).

4. Interventions for dysphagia

Interventions aimed at addressing dysphagia encompass a range of strategies, including postural adjustments, dietary modifications, and swallowing rehabilitation (*90-92*). These interventions aim to improve swallowing function, enhance coordination and efficiency, and mitigate the incidence of dysphagia and associated complications. Postural adjustments play a pivotal role in enhancing swallowing function and mitigating the risk of aspiration. This can be achieved by optimizing the patient's posture during meals, such as maintaining an upright position and performing the chin-down maneuver (*93,94*). In addition, dietary management involves altering food consistency, regulating bolus flow, and alternating between solid and liquid intake (*95*). Such therapeutic interventions seek to bolster patient tolerance and reduce the likelihood of aspiration pneumonia and pulmonary infections (*95,96*).

Swallowing rehabilitation entails targeted exercises aimed at strengthening specific muscles or muscle groups in the oral cavity and pharynx. Techniques such as progressive tongue resistance exercises and the Shaker exercise are used to enhance physiological swallowing function and mitigate complications associated with dysphagia (*15,97*).

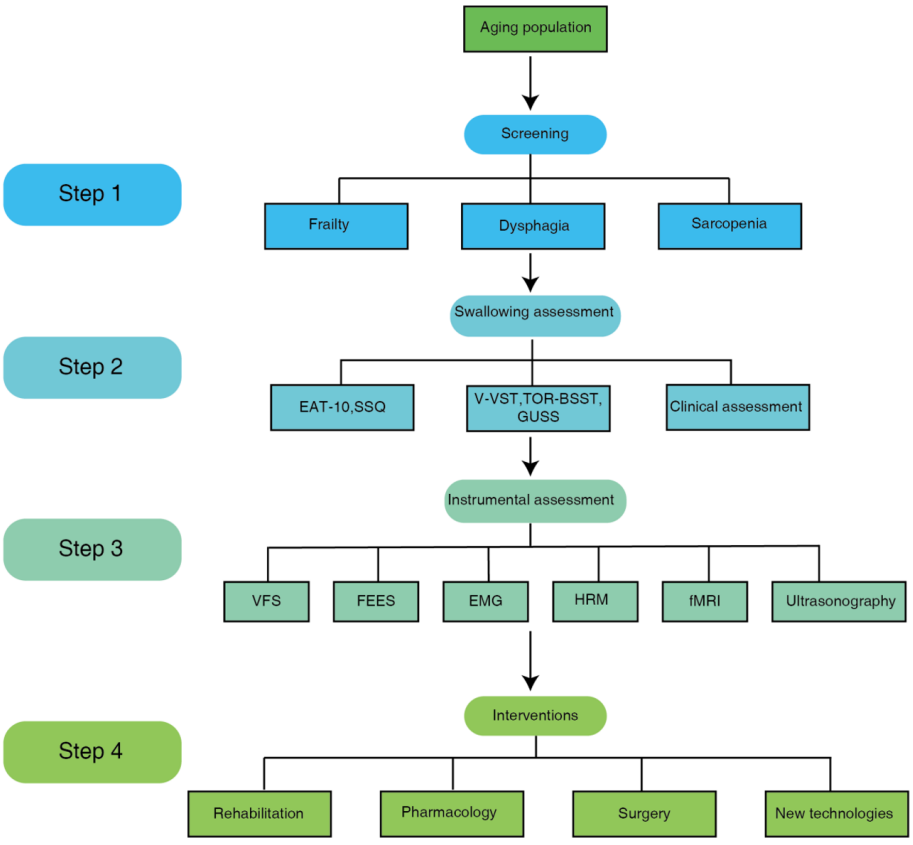

Figure 1. Diagnosis and treatment options for dysphagia in the aging population. Abbreviations: EAT-10, 10-Item Eating Assessment Tool; EMG, electromyography; FEES, fiberoptic endoscopic evaluation of swallowing; fMRI, functional magnetic resonance imaging; GUSS, Gugging Swallowing Screen; HRM, high-resolution manometry; SSQ, Sydney Swallow Questionnaire; TOR-BSST, Toronto Bedside Swallowing Screening Test; VFS, videofluoroscopy; V-VST, Volume-Viscosity Swallow Test.

Pharmacologic and surgical interventions are pivotal in addressing dysphagia, serving as adjuncts or primary treatments tailored to specific etiologies. In terms of pharmacotherapy, patients with dysphagia are advised to consider reducing the use of medications known to adversely affect swallowing function, such as antipsychotics (*98*). In addition, certain excitatory drugs like capsaicin, which activates transient receptor potential vanilloid type 1 (TRPV1), can enhance the swallowing response, thereby shortening swallowing response times and improving safety and efficacy (*99*).

Common options for surgical interventions include cricopharyngeal myotomy, UES dilatation, and cricopharyngeal botulinum toxin injections, aimed at enhancing push flow and eliminating UES outlet obstruction (*100-102*). Procedures such as laryngectomy, tracheoesophageal diversion, and laryngeal suspension are used to safeguard the airway and mitigate the risk of aspiration (*103-106*). In addition, endoscopic Zenker repair can improve push flow and alleviate UES outlet obstruction and push retention in diverticular pockets (*107-109*).

Moreover, physiotherapy and nutritional support, such as transgastric or transnasal gastrostomy tube (NGT) feeding, play crucial roles in dysphagia management (*110*). Among individuals with oropharyngeal dysphagia, those undergoing percutaneous endoscopic gastrostomy (PEG) requiring hospitalization have a significantly lower prevalence of pneumonia compared to those receiving NGT feeding (*111*). When formulating a treatment plan, the patient's specific circumstances and etiology, along with the effects and risks of treatment, should be carefully considered and personalized under the guidance of a physician.

The management of swallowing function necessitates the coordination of multiple systems, including the oral, pharyngeal, neurological, and muscular systems, highlighting the importance of collaborative management strategies by a multidisciplinary team. A survey of clinic attendees revealed that 43% of dysphagia patients had a history of esophageal disease, 22% had undergone head and neck radiation therapy, 14% had an underlying neurological diagnosis, 10% had undergone cervical spine surgery, and only 1% had no known medical history (*112*). Consequently, effectively treating and managing dysphagia in the elderly population with comorbidities necessitates drawing on multidisciplinary expertise.

A multidisciplinary care team typically consists of otolaryngologists, neurologists, rehabilitation medicine specialists, dietitians, and speech therapists (*113,114*). At the McGill University Health Center, for example, a comprehensive treatment plan is offered to patients, incorporating flexible endoscopic swallowing assessment, dietary modifications, swallowing therapy, medication, and surgery, thus enhancing treatment adaptability and effectiveness (*115*). Similarly, Stanford University has established a multidisciplinary dysphagia center, bringing together physicians and therapists specializing in otolaryngology, speech-language pathology, nutrition, and gastroenterology. This center delivers comprehensive treatment plans addressing symptoms and issues associated with various dysphagia types (*112*).

The multidisciplinary teamwork model is instrumental in managing dysphagia among the elderly population. It plays a crucial role in minimizing duplicate examinations, shortening the duration of treatment, and increasing satisfaction with care. Overall, this approach ensures comprehensive treatment and care for patients with dysphagia.

5. Use of new technologies

The use of new technologies holds significant promise in the treatment of dysphagia. Neuromodulation techniques, such as repetitive transcranial magnetic stimulation (rTMS), transcranial direct current stimulation (tDCS), and pharyngeal electrical stimulation (PES), have garnered considerable attention for their ability to address neurogenic dysphagia (*116-119*). These techniques primarily aim to enhance the function of the swallowing neuron network by modulating central nervous system activity, thereby improving patients' swallowing ability. In stroke patients with dysphagia, for example, rTMS treatment has been found to induce changes in the functional motor system of swallowing, including increased excitability of the pharyngeal cortex and enhanced pharyngeal sensory conduction (*118-120*). A clinical study has demonstrated the effectiveness of various rTMS protocols, including ipsilateral, contralateral, and cerebellar stimulation, in improving swallowing function and reducing dysphagia severity (*121*). Similarly, anodal tDCS applied to the contralateral sensorimotor cortex has been found to alleviate the functional severity of dysphagia in patients without adverse effects (*122*). These neuromodulation techniques offer novel treatment options for elderly patients with dysphagia of neurological origin.

As a complement to swallowing therapy, biofeedback offers patients visual or auditory signals to adjust the conscious or subconscious mechanisms involved in swallowing, thereby improving their swallowing ability (*123,124*). One such biofeedback technique, surface electromyography (sEMG), is widely used. sEMG biofeedback uses two small electrodes on the submental muscles to measure the timing and force of muscle contractions, displayed graphically on a screen (*125,126*). When combined with swallowing maneuvers, sEMG biofeedback enhances hyoid displacement in post-stroke dysphagia patients (*126*). Another innovative dysphagia treatment is Biofeedback in Strength and Skill Training (BiSSkiT) (*127*). Initial studies in neurodegenerative diseases suggest that skill training may improve

swallowing coordination and timing, potentially aiding dysphagia rehabilitation (*128,129*).

The use of stem cells to repair damaged tissue or promote tissue regeneration holds promise for dysphagia treatment. Stem cells possess the remarkable ability to self-renew and differentiate into various cell types, offering the potential to repair damaged pharyngeal tissues or reconstruct impaired neuronal networks, thereby restoring swallowing function in patients (*130*). In a clinical pilot study involving 12 patients with oculopharyngeal muscular dystrophy (OPMD) and indications for cricopharyngeus muscle myotomy, stem cell injections were administered at different pharyngeal constrictor sites post-myotomy (*131*). Six out of 12 patients had improved upper pharyngeal function at 24 months according to video endoscopy, but only 2 out of 12 patients displayed improvement according to the more sensitive videofluoroscopy (*131*). In another study, 30 patients who underwent radiotherapy for HPV-positive squamous cell carcinoma of the oropharynx were randomized to receive ultrasound-guided injections of autologous adipose tissue-derived stem cells (ADSCs) or a placebo in the submandibular gland (*131*). Patients treated with ADSCs had a significant increase in non-stimulated salivary flow rate at both 1 and 4 months, along with reduced symptoms and improved eating and thirst compared to those receiving a placebo (*131*). A tissue examination also revealed positive changes in gland tissue morphology in patients treated with ADSCs, indicating potential benefits of stem cell therapy in dysphagia management (*131*). While stem cell therapy remains in the research phase, these preliminary findings offer hope for advancing dysphagia treatment.

6. Conclusion

The current status of dysphagia in the context of aging highlights its prevalence and complexity. As the global population ages, dysphagia has emerged as a significant issue among older adults. Physiological changes related to aging, such as diminished muscle strength and coordination in the oropharyngeal region, contribute to the increased risk of swallowing problems in this demographic. In addition, age-related conditions like neurological disorders and structural changes in the pharynx further increase the likelihood of dysphagia, posing risks of complications such as aspiration pneumonia, malnutrition, and dehydration. Moreover, beyond the physical challenges, dysphagia profoundly affects the overall well-being of the elderly, leading to diminished quality of life, social isolation, and psychological distress, which in turn presents considerable challenges for caregivers and healthcare providers.

Addressing these challenges necessitates a comprehensive approach involving early detection and intervention strategies tailored to individual needs. Screening protocols, along with diagnostic tools like videofluoroscopy and fiberoptic endoscopic evaluation, play crucial roles in effective dysphagia management. Moreover, interdisciplinary collaboration among healthcare professionals including speech-language pathologists, dietitians, and physicians is essential for providing integrated care. Moving forward, continued research is vital to refining diagnostic techniques, optimizing treatment modalities, and promoting holistic approaches to improve the well-being and quality of life of older adults with dysphagia.

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**Address correspondence to:*
Ying Xia, Department of Neurosurgery, Haikou Affiliated Hospital of Central South University Xiangya School of Medicine, Haikou 570208, China.
E-mail: xiaying008@163.com

Peipei Song, National Center for Global Health and Medicine, Tokyo 162-8655, Japan.
E-mail: psong@it.ncgm.go.jp

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