HHS Public Access

Author manuscript

J Am Geriatr Soc. Author manuscript; available in PMC 2020 December 01.

Published in final edited form as:

J Am Geriatr Soc. 2019 December ; 67(12): 2643–2649. doi:10.1111/jgs.16137.

Swallowing Disorders in the Older Population

Colleen Christmas, MD FACP [Associate Professor of Medicine],
Divisions of Geriatric Medicine and General Internal Medicine, Johns Hopkins School of Medicine

Nicole Rogus-Pulia, PhD, CCC-SLP [Assistant Professor]
Division of Geriatrics and Gerontology, Department of Medicine, School of Medicine and Public Health, University of Wisconsin-Madison, Geriatric Research Education and Clinical Center (GRECC), William S. Middleton Memorial Veterans Hospital

Abstract

Swallowing problems, or dysphagia, are very common as people age, and are associated with significant negative outcomes, including weight loss, pneumonia, dehydration, shortened life expectancy, reduced quality of life, and increased caregiver burden. In this paper we will discuss the complex process of swallowing in normal circumstances and with healthy aging, then review etiologies that contribute to dysphagia. We will discuss approaches to evaluating and treating dysphagia, providing relevant data where it is available. We highlight the desperate need for high quality research to guide best practices in treating dysphagia in older adults.

Keywords

Dysphagia; Swallowing; Aging; Evaluation; Intervention

The Healthy Swallowing Process

The swallowing process is remarkably complex involving six cranial nerves, multiple muscles groups, and cortical and subcortical brain signals that must be precisely coordinated within a few seconds. Swallowing has been described as consisting of three phases which may overlap with one another (see Figure). Swallowing begins with the oral preparatory phase during which the bolus is prepared to be swallowed. The bolus is masticated and mixed with saliva for moistening and salivary amylase to begin the digestive process. During the oral phase, the food and/or liquid is collected into a cohesive bolus and sequentially propelled towards the pharynx under the pressure of the muscular tongue contacting the hard palate. The oral phase is under voluntary skeletal muscle control, thus requires the participation of an alert person. In the pharyngeal phase, the tongue propels the food bolus into the pharynx which triggers a series of events that comprise the pharyngeal swallow response. These include velopharyngeal closure, base of tongue retraction to the posterior pharyngeal wall, movement of the hyoid bone and larynx, closure of the airway at three

Corresponding Author: Colleen Christmas, MD, cchristm@jhmi.edu, Phone: 410-550-4453.
Authors contributions: Both authors were involved in the writing of this manuscript and reviewed it for accuracy prior to submission.
Conflict: Neither author identifies any conflicts of interest to disclose.

levels (true vocal fold closure, false vocal fold approximation, arytenoid cartilage contact at the base of the epiglottis), contraction of the pharyngeal muscles, and opening of the upper esophageal sphincter. The pharyngeal phase is partially under voluntary control and partly involuntary. Finally, the esophageal phase of swallowing consists of a peristaltic wave of contraction that moves the food bolus through the esophagus under involuntary control.

Dysphagia

When trouble occurs with swallowing it can be described by the phase during which it occurs: oral, pharyngeal, or esophageal dysphagia. However, often patients have physiologic impairments that occur within multiple phases of the swallow. Impairments may occur in planning the motor sequence of swallowing, coordination and timing, or anatomical structural displacement during swallowing. These various impairments can lead to airway invasion in the form of penetration or aspiration. Penetration occurs when the bolus enters the laryngeal vestibule but does not move below the true vocal folds and into the trachea. Aspiration occurs when the bolus enters the laryngeal vestibule and moves into the trachea and lungs. Healthy individuals with intact laryngeal sensation will cough or clear the throat in response to airway invasion, but many patients with dysphagia have impaired sensation and do not respond (e.g., cough or throat clear) to aspiration, termed silent aspiration. During swallowing evaluations, the underlying causative biomechanical impairments are sought to best inform the creation of a treatment plan. Table 1 provides examples of levels of dysfunction, contributing diseases, and clinical presentation of dysphagia.

Causes of Dysphagia in Older Adults

Dysphagia is not itself a disease; rather, it results from a variety of medical conditions. Due to the high prevalence of dysphagia in older adults as well as its serious consequences, it has been suggested that dysphagia be considered its own geriatric syndrome(1). The most common conditions leading to oropharyngeal dysphagia include stroke, head and neck cancer, or progressive neurologic disease (e.g., dementia, amyotrophic lateral sclerosis, Parkinson’s disease). There are a multitude of etiologies of esophageal dysphagia, including esophagitis, achalasia, esophageal strictures, Zenker’s diverticula, and others. History can be very helpful in considering etiologies to guide the appropriate workup. Esophageal dysphagia that begins only involving solid food but progresses over time to also include fluids is more suggestive of a mechanical issue, such as tumor or stricture, whereas esophageal dysphagia for both solids and liquids from the outset suggests a motor problem, such as achalasia. Medical interventions (e.g., endotracheal intubation, tumor resection) and certain medications (e.g., anticholinergics) also can result in dysphagia (See Table 2).

Even healthy aging contributes to changes in eating, only some of which are related to swallowing per se. The aging process leads to alterations in olfaction and gustatory sensation that can affect appetite, dietary selection, and amount of oral intake. Sarcopenia (decreased muscle mass and quality with advancing age) has been shown to affect the muscles used for swallowing, given that they are of the skeletal type (2, 3). Due to these effects, the force generation capacity of the oral tongue has been shown to decrease with advancing age which can lead to reduced pressure generation during the oral phase and poor bolus clearance (4–

7). Changes in the muscles of mastication result in slower and inefficient chewing, which increases the risk of asphyxiation (8). Aging also results in lower salivary flow rates (9) which, in combination with medication effects, can lead to the onset of xerostomia. Many medications older adults consume also contribute to decreased appetite, incoordination, and esophagitis, further exacerbating the problem. Thus, in an older adult with concerns related to eating, it is important to distinguish whether dysphagia is a significant contributor or if other factors predominate. When dysphagia contributes, the specific swallow impairments are sought, often with a combination of careful history, examination, and potentially instrumental assessment of swallowing, in conjunction with a speech language pathologist (SLP).

Assessment of Swallowing

Despite the frequency with which swallowing problems are encountered in clinical medicine there is a striking paucity of evidence on which to base recommendations for evaluations and treatments. In evaluating swallowing function, a SLP is a critical team member when oropharyngeal dysphagia is suspected. Esophageal dysphagia is typically evaluated by endoscopy or barium swallow (esophagram), often in partnership with a gastroenterologist to identify and treat the underlying etiology. If both oropharyngeal and esophageal dysphagia are likely, one may utilize a combined videofluoroscopic swallow study with a barium swallow.

No clear guidelines on when to consult a SLP exist; most clinicians consider consultation when there are signs and symptoms of swallowing problems or when the patient has newly developed a clinical condition highly associated with swallowing problems. More recent shifts in paradigms of care for older patients with neurodegenerative conditions (e.g., Parkinson’s disease, dementia) have resulted in the inclusion of the SLP in geriatrics and memory clinics as a member of the interdisciplinary team to allow for their involvement from diagnosis through end of life. Signs and symptoms of swallowing problems are coughing while trying to swallow, nasal regurgitation of food, wet vocal quality after swallowing, poor secretion management, weak cough, or a feeling of food getting stuck or requiring regurgitation. Concerns may be heightened in patients with known neurologic or aerodigestive impairments that increase the risk of swallowing disorders, such as stroke or patients with head and neck treated with chemoradiation. Further, it is important that the patient is able to participate in the clinical and/or instrumental swallowing assessment and any recommendations made based on the results of this assessment, such as swallowing exercises. Thus, performing swallowing assessments on delirious patients who cannot fully participate may be futile. Finally, a swallowing evaluation by a SLP can be pursued to gather further information when the clinical scenario is unclear. There are two main types of swallowing evaluations: a clinical evaluation often at the bedside and an instrumental assessment, which include videofluoroscopic swallowing studies (VFSS) and fiberoptic endoscopic evaluations of swallowing (FEES).There are advantages and drawbacks to each and limited guidance in terms of preferred approaches for various clinical scenarios. Older adults have higher rates of silent aspiration than younger adults, further making clinical bedside evaluations less reliable in those for whom this is suspected. Further research is

indicated to identify patients for whom these examinations are most useful prognostically and therapeutically.

When evaluating a patient for oropharyngeal dysphagia, the SLP begins the assessment with a clinical evaluation that involves a thorough review of medical history, an interview with the patient and/or caregiver/family, a cranial nerve examination, and administration of liquid and food of varying textures and sizes. The goal of the clinical evaluation is to determine whether signs of dysphagia are present, warranting further evaluation with an instrumental assessment. The SLP also gains valuable information about the patient's reported symptoms, cognitive state, fatigue during a meal, posture, positioning, environmental conditions, and readiness for further evaluation. There is insufficient evidence linking these assessments to clinically meaningful outcomes, and the data supporting bedside evaluations alone to determine treatment interventions is not supported by evidence (10, 11).

The VFSS is the most common type of instrumental assessment. During the VFSS, various volumes and viscosities of barium are administered, and the oropharyngeal region is visualized radiographically. The SLP can determine the specific swallowing impairments present as well as the safety and efficiency of the swallow. The SLP also uses this study to determine whether certain intervention strategies (e.g., postural changes, dietary modifications, swallowing maneuvers) are effective in improving swallow function which guides the treatment plan. During FEES flexible endoscope is inserted through the nose and into the upper pharynx. This allows for visualization of the pharyngeal and laryngeal anatomy as well as the swallowing process while the patient is eating and drinking regular foods/fluids.

In a retrospective study of nursing home patients followed for a year, researchers showed that aspiration on VFSS predicted rehospitalization but not pneumonia or pneumonia death(12). In another cohort study, aspiration on VFSS predicted both pneumonia and death, but not dehydration, in patients with stroke followed for 16 months(13). Hospitals adherent with dysphagia screening programs after stroke tended to have lower rates of pneumonia than those who did not utilize dysphagia screening protocols in one study(14); this association cannot prove causation but is intriguing. While results of some clinical evaluations and instrumental assessments (e.g., VFSS and FEES) have been shown to be associated with important outcomes for patients with dysphagia, others have failed to demonstrate this benefit(15); more research focused on understanding the benefits and drawbacks of these evaluation techniques is needed.

Management of Dysphagia in Older Adults

Interventions for dysphagia include both compensatory and rehabilitative methods with the goal of improving swallow function, thereby reducing the occurrence of aspiration, pneumonia, and choking.

Compensatory techniques

Compensatory techniques are designed to minimize or eliminate symptoms or adverse sequelae of dysphagia but do not change the underlying physiology of the swallow. These

approaches include oral care, postural changes, swallowing maneuvers,eating strategies , and dietary modifications.

While not directly impacting swallowing function, limited evidence supports the use of oral care to reduce the risk of developing pneumonia from aspiration in nonventilated patients. In one meta-analysis, oral care interventions reduced the risk of pneumonia and fatal pneumonia but there was a high risk of bias in all studies (16).

\Postural changes, such as chin down (positioning the chin to the chest) or head turn (turning head over right or left shoulder), have been shown to change the biomechanics and pressure generation during swallowing and to reduce the occurrence of aspiration depending upon the swallow impairments present(17–21). Additionally, swallowing maneuvers, such as the effortful swallow, also impact swallowing physiology and may have positive effects on pharyngeal pressure generation.

Another common practice is to alter the consistency of fluids and solids in patients with dysphagia; however, more research is needed to elucidate the benefits and risks of this practice on clinical outcomes. There are gradations of liquid and solid foods that may be recommended for a patient based on what is observed to be safest and most efficient on the VFSS. The recently developed International Dysphagia Diet Standardisation Initiative (IDDSI) has been successful in establishing standard international terminology and definitions for texture-modified foods and liquids (22) (See Table 3). While it has been suggested thicker liquids (e.g., honey-thick consistency) may improve some measures of swallowing, such as decreases in the occurrence of airway invasion on videofluoroscopy, increases in dehydration with decreases in quality of life have also been reported(23). Additionally, studies have shown adherence to recommendations for thickened liquids to be low overall (24). Studies evaluating the impact of modification of food and fluid consistency on the incidence of aspiration for patients with head and neck cancer (25) and with Parkinsons disease(26) are low quality and inconclusive. A recent Cochrane review found no qualifying studies related to altering food consistency and only two studies (parts of the same clinical trial) evaluating the use of honey- or nectar-thick liquids versus regular liquids with a chin tuck posture for patients with dementia or Parkinson’s disease and comorbid dysphagia. They found that both nectar- and honey-thick liquids reduced videofluoroscopic aspiration compared to thin liquids. While honey-thick liquids were associated with higher rates of pneumonia (27) compared to chin tuck posture with thin liquids, the study was not adequately powered for pneumonia as an outcome.

Thus, we have limited and insufficient evidence to understand the risks and benefits of compensatory approaches, including altered fluid and food consistencies, on important clinical outcomes. Such limitations in our evidence base should be acknowledged in discussions with families and in considering the strength of our treatment recommendations. Further research to elucidate the impact of these compensatory approaches on swallowing function, quality of life, and clinical outcomes is needed and the creation of evidence-based protocols are desperately needed. Physicians should work with SLPs to understand the most pressing areas needing advocacy for funding of research.

Feeding tubes

Feeding tubes may be placed in patients with dysphagia of a variety of etiologies either with complete elimination of oral intake or in conjunction with modification of oral intake, often in an attempt to reduce the risk of aspiration. When contaminated oral secretions are aspirated in high enough inoculum to overcome host defenses, a polymicrobial aspiration pneumonia may occur with associated high morbidity and mortality. Aspiration of gastric contents usually causes a chemical irritation to the lungs, contributing to fever, tachypnea, and rales usually resolving over the course of 24 hours without requiring antibiotics (28). This latter syndrome is known as Mendelson's syndrome, or aspiration pneumonitis. The placement of a feeding tube does nothing to improve the ability to swallow. Therefore, misdirection of contaminated oral secretions, the most common contributor to contributor to aspiration pneumonia, is not reduced or eliminated by the placement of a feeding tube or any kind(29, 30). Further, in animal studies it is been demonstrated that reflux of gastric contents is increased due to a reduction in the pressure of the lower esophageal sphincter with a gastrostomy tube in place(31). Thus, it is not surprising that ample evidence fails to demonstrate a reduction of aspiration of gastric contents or the occurrence of aspiration pneumonia from misdirected oral secretions after feeding tubes are placed(32). Indeed, feeding tubes pose one of the highest risk factors for aspiration pneumonia in these populations(33). Ongoing research is studying whether the use of feeding tube alters oral flora, and whether this change may contribute to pneumonia risk.

Additionally, feeding tubes are associated with their own risks. While in most patients they are quite easy to insert, long-term outcomes are concerning. Gastrostomy tubes are associated with cellulitis, fasciitis, and bacteremia. Nasogastric tubes are associated with increased agitation, frequently requiring the use of restraints in patients with dementia. They are also associated with a higher risk of sinus infection and nasal irritation. Both forms of tube feeding represent a significant risk factor for the development of both infectious and noninfectious diarrhea, which may be especially problematic in a bedridden patient with dementia who may have bedsores Indeed, in one cohort study of nursing home residents with severe cognitive impairment, the placement of a feeding tube was associated with double the risk of developing a stage 2 or greater pressure ulcer and slower healing of existing sores compared to matched patients without tubes (34). In patients with significant dysphagia and dementia we know that survival is equally short with and without a feeding tube, around 6 months. Several studies suggest that survival is shorter in patients with dementia and dysphagia who were fed by tube rather than by hand, but this evidence is inconclusive. There is no evidence to support that feeding tubes prolong survival in patients with dementia and dysphagia (35). In patients with dysphagia from acute stroke, the FOOD trial demonstrated no improvement in recovery of function or length of stay for patients who have feeding tubes placed at admission versus waiting for a week. Indeed 50% of those patients randomized to delayed placement never received a feeding tube because they recovered swallowing ability in that time; those who had early placement of feeding tubes had higher rates of GI bleeding and higher rates of utilization of feeding tubes at the end of the study (36). Further, while feeding tubes may contribute to elevated risk of cellulitis and infectious diarrhea, there is no evidence to support the notion that infections of any kind can be reduced with use of feeding tubes. Similarly, there is a paucity of evidence evaluating

function as an important outcome or how the presence of a feeding tube impacts quality of life.

In 2014 the Ethics and Clinical Practice Committees of the American Geriatrics Society published a comprehensive review of the evidence around feeding tubes and dementia and issued position statements. Given the wealth of information suggesting that feeding tubes provide no meaningful clinical benefit to patients with dementia and dysphagia and may in fact be associated with some poorer outcomes, the position statement of the American Geriatrics Society suggests that placement of feeding tubes in patients with dementia is a practice that should be seriously reconsidered and endorsed careful hand feeding as the preferred, albeit labor intensive, approach (37). For patients with acute dysphagic stroke data suggest that the placement of a gastrostomy tube may be safely delayed a week; whether longer delays are beneficial or harmful are unknown. For patients with progressive motor neuron diseases, esophageal cancer, and many other diseases associated with dysphagia, there is precious little evidence on which to guide treatment decisions.

Rehabilitative Interventions

Rehabilitative interventions are designed to improve the biomechanics of swallowing through strength and/or skill-based treatment paradigms. These may include exercise regimens or training to improve planning of the swallowing motor sequence and coordination within the events of the swallow.

As previously mentioned, declines in force generation by the tongue and pharyngeal muscles have been documented with advancing age and in patients with dysphagia. Swallowing maneuvers, such as the effortful swallow and the Mendelsohn maneuver where the patient is instructed to voluntarily hold the larynx in its uppermost position for 2–3 seconds before completing the swallow, used within an exercise paradigm have been shown to benefit swallowing-related outcomes in multiple patient populations (17, 38, 39). Progressive, intensive lingual strengthening exercise regimens facilitated by devices that provide biofeedback have also resulted in positive changes in lingual strength with some carryover to swallowing function for older adults and patients post-stroke (40). Expiratory muscle strength training positively impacts other components of swallowing (41, 42). The McNeill Dysphagia Therapy Program (MDTP) is a progressive strengthening program that incorporates a hard swallow across a hierarchy of progressively more challenging feeding tasks. This approach has been shown to improve the severity of dysphagia in several patient groups (43).

A recent Cochrane review found low- and very low-quality evidence that swallowing interventions, as compared to no swallowing intervention, may have reduced the number of individuals with dysphagia and chest infection and may improve swallowing ability. Moderate quality evidence suggested that swallowing interventions reduced hospital length of stay but that these interventions did not reduce case fatality rate or the combined outcome of death or disability(44). Higher quality evidence to support the positive impact of rehabilitative interventions for dysphagia in older adults with a variety of etiologies are desperately needed.

The Importance of Collaboration in Dysphagia Management

Interprofessional team partnerships and engagement of families and caregivers in discussions regarding the diagnosis and recommended treatment for patients with dysphagia is necessary in order to achieve optimal care. One study demonstrated that involvement of a geriatrician in the discussion at the time a feeding tube was considered in the hospital setting resulted in a 50 % reduction in the placement of feeding tubes (45). Early involvement of a SLP will be critical to ensuring thorough assessment and follow-up for older patients with dysphagia, especially those who require proactive intervention to potentiate neural recovery (e.g., stroke) or to maintain swallow function as long as possible into disease progression (e.g., dementia). Caregiver education and training will be critical to the carryover of any recommendations, including the implementation of a rehabilitative approach. In one study, use of a video guided tool to facilitate advanced care planning in patients with dementia reduced the use of feeding tubes in patient for whom comfort measures were the preference for care (46).

The cultural values and emotional valence around feeding may have little to do with evidence or face validity when considering the evaluations and treatment plans for older adults with swallowing difficulties; all such values should be carefully explored and will weigh on challenging decisions of this sort. Whenever possible, it may be useful to engage trusted advisors, such as religious figures, family, friends, and long-term physicians, to contribute to discussions. Critically important is ensuring the health care team facilitates a collaborative and humble approach to care, acknowledging shared goals and approaching the limitations in our knowledge base with humility.

Summary

Swallowing is a complex process and dysphagia is incredibly common with advancing age. Dysphagia can be asymptomatic, but often contributes to significant reductions in quality of life for patients and caregivers, discomfort with eating, higher risks of pneumonia and dehydration, and weight loss and debility. For patients with stroke and dementia, dysphagia is highly associated with reduced survival, and can serve as a prompt to explore goals of care and values near the end of life. These discussions are often highly stressful for patients and families and health care providers as well, so considerable effort invested in building trust and understanding and valuing preferences can reduce the burden involved in creating and navigating treatment plans.

Evidence to support early evaluation and treatment of dysphagia in older adults is limited and more research with larger cohorts and improved study design is needed. Fortunately, exciting research should shed new evidence regarding the underlying mechanisms of dysphagia in older adults and the optimal treatments for these impairments in the years ahead.

There are many areas where this research is critically needed. Underlying mechanisms and the results of interventions targeting these mechanisms are still at nascent stages of investigation. Also, it has been shown that swallowing dysfunction begins early in

Alzheimers-type dementia (47). Whether direct interventions to strengthen and improve swallowing function in early stage dementia, at a time where the patient is cognitively able to participate in such therapies and before they have a negative impact on swallowing, has a lot of face validity and is currently an area of active research. The impact of swallowing evaluation and treatment on broader health outcomes, such as pneumonia and nutritional status, in older adults requires elucidation. As eating and swallowing are so intimately linked to quality of life, it is critical that future studies include standard measures of the impact of evaluations and interventions on quality of life in those populations who are able to participate in such an assessment.

Acknowledgments:

Sponsors' role: This article was partially prepared within the Geriatric Research Education and Clinical Center (GRECC) at the William S. Middleton Veteran Affairs Hospital in Madison, WI. Dr. Rogus-Pulia's research on dysphagia in persons with Alzheimer's disease is supported by the National Institute on Aging of the National Institutes of Health under award number 1K23AG057805-01A1. The views and content expressed in this article are solely the responsibility of the authors and do not necessarily reflect the position, policy, or official views of the Department of Veteran Affairs, the U.S. government, or the National Institutes of Health.

References

1. Baijens LW, Clavé P, Cras P, Ekberg O, Forster A, Kolb GF, et al. European Society for Swallowing Disorders - European Union Geriatric Medicine Society white paper: oropharyngeal dysphagia as a geriatric syndrome. Clin Interv Aging. 2016;11:1403–28. [PubMed: 27785002]
2. Molfenter SM, Lenell C, Lazarus CL. Volumetric Changes to the Pharynx in Healthy Aging: Consequence for Pharyngeal Swallow Mechanics and Function. Dysphagia. 2019 02;34(1):129–37. [PubMed: 30039259]
3. Buehring B, Hind J, Fidler E, Krueger D, Binkley N, Robbins J. Tongue strength is associated with jumping mechanography performance and handgrip strength but not with classic functional tests in older adults. J Am Geriatr Soc. 2013 3;61(3):418–22. [PubMed: 23379330]
4. Sakai K, Nakayama E, Tohara H, Kodama K, Takehisa T, Takehisa Y, et al. Relationship between tongue strength, lip strength, and nutrition-related sarcopenia in older rehabilitation inpatients: a cross-sectional study. Clin Interv Aging. 2017;12:1207–14. [PubMed: 28814847]
5. Park J, Oh D, Chang M. Comparison of maximal tongue strength and tongue strength used during swallowing in relation to age in healthy adults. J Phys Ther Sci. 2016 1;28(2):442–5. [PubMed: 27064477]
6. Hara K, Tohara H, Kobayashi K, Yamaguchi K, Yoshimi K, Nakane A, et al. Age-related declines in the swallowing muscle strength of men and women aged 20–89 years: A cross-sectional study on tongue pressure and jaw-opening force in 980 subjects. Arch Gerontol Geriatr. 2018 Sep-Oct;78:64–70. [PubMed: 29902686]
7. Nicosia MA, Hind JA, Roecker EB, Carnes M, Doyle J, Dengel GA, et al. Age effects on the temporal evolution of isometric and swallowing pressure. J Gerontol A Biol Sci Med Sci. 2000 11;55(11):634.
8. Morita K, Tsuka H, Kato K, Mori T, Nishimura R, Yoshida M, et al. Factors related to masticatory performance in healthy elderly individuals. J Prosthodont Res. 2018 10;62(4):432–5. [PubMed: 29706464]
9. Affoo RH, Foley N, Garrick R, Siqueira WL, Martin RE. Meta-Analysis of Salivary Flow Rates in Young and Older Adults. J Am Geriatr Soc. 2015 10;63(10):2142–51. [PubMed: 26456531]
10. O'Horo JC, Rogus-Pulia N, Garcia-Arguello L, Robbins J, Safdar N. Bedside diagnosis of dysphagia: a systematic review. J Hosp Med. 2015 4;10(4):256–65. [PubMed: 25581840]
11. Virvidaki IE, Nasios G, Kosmidou M, Giannopoulos S, Milionis H. Swallowing and Aspiration Risk: A Critical Review of Non Instrumental Bedside Screening Tests. J Clin Neurol. 2018 7;14(3):265–74. [PubMed: 29504298]

12. Croghan JE, Burke EM, Caplan S, Denman S. Pilot study of 12-month outcomes of nursing home patients with aspiration on videofluoroscopy. Dysphagia. 1994;9(3):141–6. [PubMed: 8082320]
13. Schmidt J, Holas M, Halvorson K, Reding M. Videofluoroscopic evidence of aspiration predicts pneumonia and death but not dehydration following stroke. Dysphagia. 1994;9(1):7–11. [PubMed: 8131429]
14. Hinchey JA, Shephard T, Furie K, Smith D, Wang D, Tonn S. Formal dysphagia screening protocols prevent pneumonia. Stroke. 2005 9;36(9):1972–6. [PubMed: 16109909]
15. Aviv JE. Prospective, randomized outcome study of endoscopy versus modified barium swallow in patients with dysphagia. Laryngoscope. 2000 4;110(4):563–74. [PubMed: 10764000]
16. Kaneoka A, Pisegna JM, Miloro KV, Lo M, Saito H, Riquelme LF, et al. Prevention of Healthcare-Associated Pneumonia with Oral Care in Individuals Without Mechanical Ventilation: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Infect Control Hosp Epidemiol. 2015 8;36(8):899–906. [PubMed: 25857604]
17. McCullough GH, Kim Y. Effects of the Mendelsohn maneuver on extent of hyoid movement and UES opening post-stroke. Dysphagia. 2013 12;28(4):511–9. [PubMed: 23494471]
18. Ra JY, Hyun JK, Ko KR, Lee SJ. Chin tuck for prevention of aspiration: effectiveness and appropriate posture. Dysphagia. 2014 10;29(5):603–9. [PubMed: 25012700]
19. Leigh J, Oh B, Seo HG, Lee GJ, Min Y, Kim K, et al. Influence of the chin-down and chin-tuck maneuver on the swallowing kinematics of healthy adults. Dysphagia. 2015 2;30(1):89–98. [PubMed: 25358491]
20. McCulloch TM, Hoffman MR, Ciucci MR. High-resolution manometry of pharyngeal swallow pressure events associated with head turn and chin tuck. Ann Otol Rhinol Laryngol. 2010 6;119(6):369–76. [PubMed: 20583734]
21. Nagy A, Peladeau-Pigeon M, Valenzano TJ, Namasivayam AM, Steele CM. The effectiveness of the head-turn-plus-chin-down maneuver for eliminating vallecular residue. Codas. 2016 4;28(2):113–7. [PubMed: 27191873]
22. Cichero J, Lam P, Steele C, Hanson B, Chen J, Dantas R, et al. Development of International Terminology and Definitions for Texture-Modified Foods and Thickened Fluids Used in Dysphagia Management: The IDDSI Framework. Dysphagia. 2017 4;32(2):293–314. [PubMed: 27913916]
23. Newman R, Vlardell N, Clave P, Speyer R. Effect of bolus viscosity on the safety and the kinematics of the swallow reflex with oropharyngeal dysphagia. Dysphagia. 2015;31:232–49.
24. Krekeler B, Broadfoot C, Johnson S, Connor N, Rogus-Pulia N. Patient Adherence to Dysphagia Recommendations: A Systematic Review. Dysphagia. 2018 4;33(2):173–84. [PubMed: 28965240]
25. Barbon CEA, Steele CM. Efficacy of Thickened Liquids for Eliminating Aspiration in Head and Neck Cancer. Otolaryngology–Head and Neck Surgery. 2015 2;152(2):211–8. [PubMed: 25358345]
26. Logemann JA, Gensler G, Robbins J, Lindblad AS, Brandt D, Hind JA, et al. A Randomized Study of Three Interventions for Aspiration of Thin Liquids in Patients With Dementia or Parkinson's Disease. Journal of Speech, Language, and Hearing Research. 2008 2 1,;51(1):173–83.
27. Flynn E, Smith CH, Walsh CD, Walshe M. Modifying the consistency of food and fluids for swallowing difficulties in dementia. Cochrane Database Syst Rev. 2018 9 24,;9:CD011077.
28. Marik PE. Aspiration pneumonitis and aspiration pneumonia. N Engl J Med. 2001 3 01,;344(9):665–71. [PubMed: 11228282]
29. Kikutani T, Tamura F, Tashiro H, Yoshida M, Konishi K, Hamada R. Relationship between oral bacteria count and pneumonia onset in elderly nursing home residents. Geriatr Gerontol Int. 2015 4;15(4):417–21. [PubMed: 25130073]
30. Wirth R, Dziewas R, Beck AM, Clavé P, Hamdy S, Heppner HJ, et al. Oropharyngeal dysphagia in older persons - from pathophysiology to adequate intervention: a review and summary of an international expert meeting. Clinical interventions in aging. 2016;11:189–208. [PubMed: 26966356]
31. Canal DF, Vane DW, Goto S, Gardner GP, Grosfeld JL. Reduction of lower esophageal sphincter pressure with stamm gastrostomy. Journal of Pediatric Surgery. 1987 1 1,;22(1):54–7. [PubMed: 3819994]

32. Finucane TE, Bynum JP. Use of tube feeding to prevent aspiration pneumonia. The Lancet. 1996 /11/23;348(9039):1421–4.
33. Manabe T, Teramoto S, Tamiya N, Okochi J, Hizawa N. Risk Factors for Aspiration Pneumonia in Older Adults. PLoS ONE. 2015;10(10):e0140060.
34. Teno JM, Gozalo P, Mitchell SL, Kuo S, Fulton AT, Mor V. Feeding Tubes and the Prevention or Healing of Pressure Ulcers. Archives of Internal Medicine. 2012 5 14,;172(9):697–701. [PubMed: 22782196]
35. Finucane TE, Christmas C, Travis K. Tube feeding in patients with advanced dementia: a review of the evidence. JAMA. 1999 10 13,;282(14):1365–70. [PubMed: 10527184]
36. Dennis MS, Lewis SC, Warlow C. Effect of timing and method of enteral tube feeding for dysphagic stroke patients (FOOD): a multicentre randomised controlled trial. Lancet. 2005 2 26-3 4;365(9461):764–72. [PubMed: 15733717]
37. American Geriatrics Society feeding tubes in advanced dementia position statement. J Am Geriatr Soc. 2014 8;62(8):1590–3. [PubMed: 25039796]
38. Park J, Oh J, Lee HJ, Park S, Yoon T, Kwon BS. Effortful swallowing training coupled with electrical stimulation leads to an increase in hyoid elevation during swallowing. Dysphagia. 2009 9;24(3):296–301. [PubMed: 19255707]
39. Clark HM, Shelton N. Training effects of the effortful swallow under three exercise conditions. Dysphagia. 2014 10;29(5):553–63. [PubMed: 24913837]
40. Rogus-Pulia N, Rusche N, Hind JA, Zielinski J, Gangnon R, Safdar N, et al. Effects of Device-Facilitated Isometric Progressive Resistance Oropharyngeal Therapy on Swallowing and Health-Related Outcomes in Older Adults with Dysphagia. J Am Geriatr Soc. 2016 2;64(2):417–24. [PubMed: 26804715]
41. Pitts T, Bolser D, Rosenbek J, Troche M, Okun MS, Sapienza C. Impact of expiratory muscle strength training on voluntary cough and swallow function in Parkinson disease. Chest. 2009 5;135(5):1301–8. [PubMed: 19029430]
42. Hegland KW, Davenport PW, Brandimore AE, Singletary FF, Troche MS. Rehabilitation of Swallowing and Cough Functions Following Stroke: An Expiratory Muscle Strength Training Trial. Arch Phys Med Rehabil. 2016 8;97(8):1345–51. [PubMed: 27130637]
43. Crary MA, Carnaby GD, LaGorio LA, Carvajal PJ. Functional and physiological outcomes from an exercise-based dysphagia therapy: a pilot investigation of the McNeill Dysphagia Therapy Program. Arch Phys Med Rehabil. 2012 7;93(7):1173–8. [PubMed: 22365489]
44. Bath PM, Lee HS, Everton LF. Swallowing therapy for dysphagia in acute and subacute stroke. Cochrane Database Syst Rev. 2018 10 30,;10:CD000323.
45. Swaminath A, Longstreth GF, Runnman EM, Yang S. Effect of physician education and patient counseling on inpatient nonsurgical percutaneous feeding tube placement rate, indications, and outcome. South Med J. 2010 2;103(2):126–30. [PubMed: 20065910]
46. Mitchell SL, Shaffer ML, Cohen S, Hanson LC, Habtemariam D, Volandes AE. An Advance Care Planning Video Decision Support Tool for Nursing Home Residents With Advanced Dementia: A Cluster Randomized Clinical Trial. JAMA Intern Med. 2018 7 01,;178(7):961–9. [PubMed: 29868778]
47. Humbert IA, McLaren DG, Kosmatka K, Fitzgerald M, Johnson S, Porcaro E, et al. Early deficits in cortical control of swallowing in Alzheimer's disease. J Alzheimers Dis. 2010;19(4):1185–97. [PubMed: 20308785]

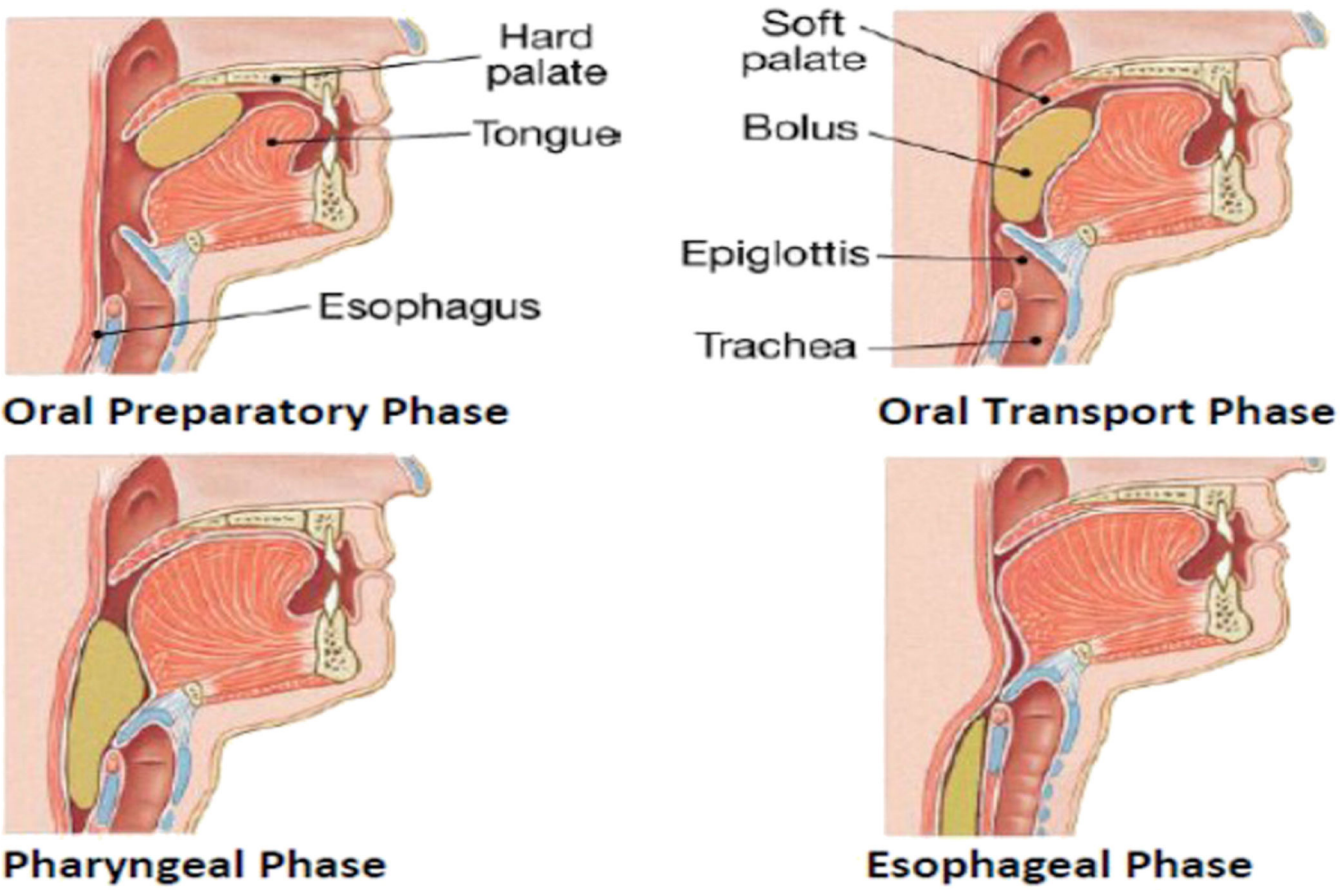

Figure 1:
Normal Phases of Swallowing

Table1:

Examples of Levels of Dysfunction, Contributing Diseases, and Clinical Presentation of Dysphagia

Phase of Swallowing	Normal Function	Examples of Impairment in Function	Examples of Diseases Causing Impairment	Clinical Presentation of Impairment
Oral	Food is chewed and mixed with saliva and the food bolus is moved to the back of the mouth	Apraxia from dementia Reduced level of consciousness Xerostomia Tongue weakness	Dementia Delirium Medications that cause inattention, sedation, or dry mouth	“Cheeking” of food, or oral residue of food Prolonged chewing
Pharyngeal	The tongue propels the food bolus into the pharynx triggering a series of events to move the bolus through the pharynx and into the esophagus while protecting the airway	Tongue weakness Pharyngeal weakness Vocal cord dysfunction	Stroke Pharyngeal tumor or abscess Vocal cord trauma Amyotrophic Lateral Sclerosis Parkinson’s Disease	Nasal regurgitation of food Wet vocal quality after swallowing Coughing while eating Throat clearing Aspiration
Esophageal	The food bolus is moved down the esophagus by peristalic muscle contraction, with the aid of gravity	Mechanical obstruction of food bolus Esophageal muscle impairment Impairment of lower esophageal muscle tone	Esophageal tumor, stricture, diverticulum Esophagitis Achalasia	Food impaction sensed in the chest area Regurgitation of undigested food Progressive dysphagia

Table 2:

Examples of Medications That Contribute To Dysphagia

Impact on Swallowing	Example Classes of Drugs
Reduce attention and oral praxis	Sedatives Neuroleptics
Cause xerostomia	Anticholinergic drugs for urinary continence Tricyclic antidepressants
Weaken tongue and mouth strength	Steroids
Impair pharyngeal phase	Antipsychotics
Impair esophageal phase	Bisphosphonates

Table 3:

International Dysphagia Diet Standardisation Initiative (IDDSI) Framework Levels, Descriptions, and Examples.

IDDSI Level	Description	IDDSI Flow or Fork Drip/Pressure Test	Example(s)
Level 0: Thin	Flows like water, fast flow	Liquid flow through 10mL slip tip syringe within 10 seconds with no residue	Water, juice, tea
Level 1: Slightly Thick	Thicker than water, more effort to drink than thin liquids; primarily used in pediatrics	Liquid flows through 10mL slip tip syringe leaving 1–4mL in syringe after 10 seconds	"Anti-regurgitation" infant formula
Level 2: Mildly Thick	Flows off a spoon, slippable but slower than thin drinks	Liquid flows through syringe leaving 4–8mL after 10 seconds	Nectar-thick liquids
Level 3: Moderately Thick	Can be drunk from a cup, some effort required to suck through a standard or wide bore straw	Liquid flows through 10mL syringe leaving >8mL after 10 seconds	Sauces and gravies, fruit syrup
Level 4: Extremely Thick- Pureed	Usually eaten with a spoon (fork is possible); cannot be drunk from a cup or sucked through a straw, does not require chewing	Flow test not applicable; Sits in a mound/pile above the fork; a small amount may flow through and form a tail below the fork tines/ prongs but does not flow continuously	Purees suitable for infants (pureed meat, thick cereal)
Level 5: Minced & Moist	Can be eaten with fork/spoon; can be scooped and shaped; soft & moist with no separate thin liquid	Flow test not applicable; sits in a pile or can mound on a fork and does not easily or completely flow or fall through tines/prongs of fork	Finely minced or chopped meat served in extremely thick, smooth, non-pouring sauce/gravy
Level 6: Soft & Bite-sized	Can be eaten with a fork/spoon; can be mashed/broken down with pressure from fork/spoon; chewing is required	Flow test not applicable; pressure from a fork held on its side can be used to "cut" or break this texture into smaller pieces	Cooked tender meat no bigger than 15mm
Level 7: Regular	Normal, everyday foods of various textures; foods may be a range of sizes	Not applicable	Any food that is hard, tough, chewy, fibrous, stringy, or dry
Transitional Foods	Foods that starts as one texture and changes into another texture specifically when moisture is applied or with a temperature change	Flow test not applicable; After moisture or temperature is applied, sample can be easily deformed and does not recover its shape when the fork is lifted	Ice chips, icecream/ sherbert; wafers, waffle cones; some biscuits/ cookies/crackers

Adapted from the IDDSI Framework and Descriptors at www.iddsi.org (License: https://creativecommons.org/licenses/by-sa/4.0/)