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REVIEW

Dysphagia in the elderly: focus on rehabilitation strategies

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Abstract Prevalence of oropharyngeal dysphagia among the elderly is high, but underestimated and underdiagnosed. It may give raise to relevant complications impacting on morbidity, hospital length of stay and health care costs. Dysphagia evaluation and management is a multidisciplinary task; it includes a detailed history taking, clinical and instrumental exams, and identification of the risk of aspiration. Long-standing individual abilities and impairments determine the goals of an ad hoc rehabilitation program. Currently there are no standard algorithmic approaches for the management of dysphagia in the elderly. Education of health professionals on early diagnosis and improvement of therapeutic strategies are mainstays to allow maximal recovery potential in this population. This narrative review summarizes the current rehabilitation approaches for dysphagia in the elderly. The aim is to inform the treating health care professionals, whether caring physician, physical medicine doctor, speech/swallowing therapist or nurse, on the state-of-the-art and stimulate discussion in the scientific community.

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Definition and prevalence

Dysphagia is a symptom of difficulty during the progression of the alimentary bolus from the mouth to the stomach. A structural or functional causes may determine it at the level of oropharyngx or esophagus [1, 2].

Older adults can be at risk for dysphagia. These changes, termed presbyphagia, refer to peculiar alterations in the swallowing mechanism of otherwise healthy older adults [3]. OD among the elderly is extremely high. OD affects up to 30–40 % of people older than 65 years [4]. Prevalence of OD is higher in neurodegenerative diseases (up to 80 %), stroke (>30 %), Parkinson (52–82 %), Alzheimer (84 %) [2, 5–7]. Among hospitalized elderly it is higher than 51 %, with an impact on morbidity, hospital length of stay and health care costs [8]. OD in elderly is rarely systemically investigated, and may give rise to two complications: reduced efficacy of deglutition, leading to malnutrition and/or dehydration, and reduced deglutition safety, with oropharyngeal aspiration, choking and tracheobronchial aspiration [9]. OD is considered a major geriatric syndrome: its prevalence is high in the geriatric population, and it contributes in precipitating diseases [10].

This narrative review summarizes the current rehabilitation approaches for dysphagia in the elderly, after overviewing etiologies and clinical evaluation. The aim is to inform the treating health care professionals, whether caring physician, physical medicine doctor, speech/swallowing therapist or nurse, on the state-of-the-art and stimulate discussion in the scientific community.

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Dysphagia etiologies in the elderly

Presbyphagia

Swallowing physiology changes with advancing age. Presbyphagia is a general slowing of swallowing, affecting oropharyngeal and esophageal phases [11, 12]. The effective and efficient flow of swallowed materials through the upper aerodigestive tract is negatively influenced by age-related changes (Tables 1, 2, 3).

Increased frequency of swallowed material penetration and aspiration and greater post-swallow residue during meals can occur [13]. Beyond subtle motor changes, age-related decrements in oral moisture, taste and smell acuity may contribute to reduced swallowing performance in the elderly [14].

Alterations in the oral phase Structural alterations in the oral apparatus can lead to functional disorder of oral phase (Table 1).

Alterations in the pharyngeal phase Aging of pharyngeal structures impairs swallowing mechanism and airway protection (Table 2).

Alterations in the esophageal phase Dysfunctions of the esophageal motility and esophageal sphincters curb transit of bolus from pharynx to stomach (Table 3).

Table 1 Alterations in the oral phase

Alterations	Consequences
Deterioration of the dental apparatus	Difficulties in bolus preparation and propulsion towards the pharynx
Xerostomia	
Sensory changes	
Reduced strength of the masticatory muscles	
Reduced tongue movement and pressure	

Table 2 Alterations in the pharyngeal phase

Alterations	Consequences
Delayed triggering of the pharyngeal swallowing reflex	Increased length of pharyngeal swallowing time, reduced hyoid elevation, bolus dropping into the pharynx/larynx and stasis in the valleculae and pyriform sinuses
Reduced strength of pharyngeal muscles	
Decreased strength of suprahyoid muscles	
Delayed opening of upper esophageal sphincter	

Table 3 Alterations in the esophageal phase

Alterations	Consequences
Upper esophageal sphincter dysfunction	Bolus retention in proximal esophagus, intraesophageal reflux, esophagitis, gastroesophageal reflux
Decreased esophageal peristalsis	
Polyphasic esophageal contractions	
Esophageal dilatation	
Lower esophageal sphincter dysfunction	

Main disorders responsible for swallowing dysfunction

The principal risks for dysphagia in older cohorts are neurologic and neuromuscular disorders; pathologies involving head and neck can directly compromise the effector muscles of swallowing. See Table 4 for detailed listing.

Drugs responsible for swallowing dysfunction

Dysphagia can have iatrogenic causes; several drugs, either directly or indirectly, damage swallowing effector organs (Table 5).

Diagnosis

A multidisciplinary approach is needed in OD diagnosis and management. Several professional domains should be included in a team: neurologists, rehabilitation physicians, Ear–Nose–Throat specialists, gastroenterologists, geriatrician, radiologists, dietitians, speech–swallow therapists and nurses. The goals include: (a) early identification of patients with dysphagia; (b) diagnosis of any medical or surgical causes that may benefit from specific treatments; (c) diagnosis of functional dysphagia; (d) planning of therapeutic strategies to guarantee safe and effective deglutition and appropriate nutrition regimen. Caregivers should be involved [1, 15].

Screening

A large percentage of elderly in formal care setting suffering of OD do not receive proper diagnosis (60 %) and/or timely treatment (66 %) [7].

A swallowing assessment by the nursing staff should be considered within the first hours of a patient's admission [16]. Screening tools should be low risk, quick and low cost [17].

Table 4 Main disorders responsible for swallowing dysfunction in the elderly [23, 24]

Neurological disorders
Stroke
Traumatic brain injury
Parkinson's disease and other movement or neurodegenerative disorders
Multiple sclerosis
Alzheimer's disease and dementias
Motor neuron disease
Myasthenia gravis
Guillain–Barre syndrome and polyneuropathies
Neoplasms and structural disorders
• Primary brain tumors
• Intrinsic and extrinsic brainstem tumors
• Base of skull tumors
• Syringobulbia
• Arnold–Chiari malformation
Myopathy
• Polymyositis, dermatomyositis, inclusion body myositis
• Muscular dystrophies
Metabolic encephalopathies
Infectious disorders
• Chronic infectious meningitis
• Syphilis and lyme disease
• Diphtheria
• Botulism
• Viral encephalitis
Postpolio syndrome
Progressive supranuclear palsy
Tardive dyskinesia
Rheumatoid disorders
Polydermatomyositis
Progressive systemic sclerosis
Sjogren syndrome
Local causes
Neoplasms (oropharyngeal, laryngeal, esophageal, thyroidal, mediastinal, tracheal or lymphatic metastasis)
Head and neck surgery
Radiotherapy
Zencker diverticulum
Cervical osteophytes
Cricopharyngeal and esophageal achalasia
Endoluminal devices (nasogastric feeding tube, endotracheal tube)
Other causes
Severe respiratory compromission
Paraneoplastic syndromes
Endocrinologic disorders (hyperthyroidism, hypothyroidism, cushing)
Amyloidosis

Table 5 Drugs responsible for swallowing dysfunction [23, 25]

Drugs	Effects
Sedatives–hypnotics	Mental status changes/alterations
Anxiolytics	Gastroesophageal reflux
Antipsychotics	Dyskinesias, xerostomia
Anticonvulsants	Mental status alterations
Antidepressants	Xerostomia
Antiparkinson drugs	Dyskinesias, xerostomia
Anticholinergic drugs	Xerostomia
Myorelaxants	Mental status alterations
Antihistamines	Mental status alterations, xerostomia
Antiemetics	Mental status alterations, xerostomia
Antidiarrheal drugs	Xerostomia
Chemotherapy, antibiotics	Esophagitis, mucosal candidiasis
Alcohol	Mental status alterations
Bronchodilators	Gastroesophageal reflux
Antiangina drugs	Gastroesophageal reflux
Calcium antagonists	Gastroesophageal reflux
Biphosphonates	Esophagitis
NSAIDs	Esophagitis
Steroids	Esophagitis

Screening for dysphagia should have high sensitivity and specificity [18]. The use of a systematic screening for dysphagia can result in a significant decrease of aspiration pneumonia, and improvement in patients' general condition. The screening is performed with questionnaires, observation, or physical evidence [19].

Unlike evaluation protocols, screening tests are designed to be quick (15–20 min), relatively non-invasive and pose little risk to the patient, while identifying signs and symptoms for diagnosis [20]. Evaluating patients' ability to swallow materials of different consistencies approximates their normal daily food habits. However, it requires considerable quantities of test materials, such as different liquids, semisolids and solids, making it less feasible than tests based on water alone [21].

Screening instruments in dysphagia are very heterogeneous and developed for different groups of people. Up to date, consensus is lacking on the best or most correct method. Important factors to consider when selecting a screening tool are quality of the research study, validity of the tool, reliability in administration and feasibility in implementation [22].

Table 6 reviews validated screening tools.

The main characteristics of screening tools are reported.

– *3-oz water swallow test* (*WST*): individuals are required to drink 3 oz (90 cc) of water without interruption. Inability to complete the test, coughing, choking, or a

Table 6 Screening tools

Protocol	Administration	Completion time	Training time	Sensitivity	Specificity
3 oz water swallow test	Nurse	<2 min	10-min training	96.5 %	48.7 %
TOR-BSST	Nurse	10 min to administer	4-h training	96 %	64 %
EAT-10	Self-administered	<4 min	None	71 %	53 %
ASDS/BJH-SDS	Nurse	2 min	10-min training	94 %	66 %
Emergency Physician Swallowing Screening	Emergency physician	≤3 min	Unknown	96 %	56 %
Modified Mann assessment of swallowing ability (M-MASA)	Stroke neurologists	Minutes	Unknown	87 %	84.2
Gugging swallowing screen (GUSS)	Nurse, therapist	Unknown	Unknown	100 %	69 %
Swallowing disturbance questionnaire	Self-administered	Unknown	None	80.5 %	81.3 %
Functional oral intake scale (FOIS)	Speech and language therapists	Unknown	None	Not reported	Not reported
Massey bedside swallowing screen	Nurse	Unknown	None	100 %	100 %
Dysphagia outcome and screening test (DOSS)	Clinician	5 min	Unknown	Not reported	Not reported

wet-hoarse vocal quality either during or within 1 min of test completion prompt referral [26].

- *Toronto bedside swallowing screening test* (*TOR-BSST*): aA one-page form consisting of two brief oral exams and one section on water swallowing. Failure on any item discontinues the screen and prompts referral [27].
- *EAT-10*: ten symptom-specific items using five-point scales (0–4: no to severe problem) result in a total score ranging between 0 and 40. Based on normative data, an EAT-10 score of three or higher is abnormal. This self-administered questionnaire quantifies the severity of oropharyngeal dysphagia as experienced by the patient [28].
- *Acute stroke dysphagia screen* (*ASDS*)/*Barnes Jewish hospital stroke dysphagia screen* (*BJH-SDS*): 5-item tools on level of consciousness, symmetry/asymmetry of oropharyngeal structures. Each item is scored present/absent: if at least one is positive, screen is failed. If all items are negative, proceed to 3-oz water swallow test [29].
- *Gugging swallowing screen* (*GUSS*): stepwise bedside screen that allows a graded rating with separate evaluations for nonfluid and fluid nutrition [30].
- *The modified Mann assessment of swallowing ability* (*modified MASA*): includes 12 of 24 items from the comprehensive MASA [31]. Maximum possible score on MMASA is 100. Items comprised in MMASA are: alertness, cooperation, respiration, expressive dysphasia, auditory comprehension, dysarthria, saliva, tongue movement, tongue strength, gag, voluntary cough and palate movements [32].
- *Emergency physician swallowing screening:* a 2-tiered dysphagia screen; tier 1 examines voice quality, swallowing complaints, facial asymmetry and aphasia; tier 2 involves a water swallow test, with evaluation for swallowing difficulty, voice quality compromise and pulse oximetry desaturation [33].

Swallowing disturbance questionnaire (*SDQ*): self-reported 15 item, with 5 questions related to the oral phase and 10 questions related to the pharyngeal phase [34]. This scale was first developed as a screening tool in people with Parkinson disease.

Functional oral intake scale (*FOIS*): a tool that clinically documents changes in functional oral intake of food or liquids in stroke patients [35]. It is easy to administer and needs no training. The main limitation is that it has been validated only in people with post-stroke dysphagia.

Massey bedside swallowing screen: assesses swallowing function and reflexes among stroke victims [36]. Has been developed for use by nurses and has high sensitivity and sensibility, but the sample of the original study was limited to stroke survivors.

Dysphagia outcome and severity scale (*DOSS*): a simple seven-point scale developed to rate functional severity of dysphagia based on objective assessment and make recommendations for diet, independence and type of nutrition [37]. Although interrater (90 %) and intrarater (93 %) reliability are high, data on sensitivity and sensibility are missing.

Clinical evaluation

Clinical assessment of swallowing disorders is artificially divided into two major stages.

First stage is thorough history taking with the patient and/or care-giver; the second stage is examination of the three phases of swallowing: preparatory, oral and pharyngeal phase [38].

Examination of the preparatory phase assesses deficiencies, neurosensory abilities and disabilities in gripping, transporting food to the mouth, putting food in the mouth, olfactory, visual and auditory sensitivity, trunk and head posture.

Evaluation of swallowing time explores oral and pharyngeal phases.

Examination is first performed without food to check head and neck structures and oral cavity to identify masses, lymphadenopathy, goiter, or signs of prior surgery and radiotherapy. Laryngeal ascent can be evaluated by placing the index and middle fingers on the hyoid and laryngeal cartilages, asking the patient to swallow [39, 40].

A neurologic examination is mandatory and should include testing of sensory (V, IX, X) and motor cranial nerves (V, VII, X, XI, XII) involved in swallowing [40]. Tactile, gustative, thermal and proprioceptive sensitivity is tested in the facial, oral and lingual areas, as well as motor amplitudes, strength and coordination.

The pharyngeal region is less accessible. As the pharyngeal swallowing reflex involves motor and sensory tracts, it is examined using sound emission, and observation of the soft palate and posterior wall at rest, and during muscle contractions (tactile stimulation). The presence of abnormal reflexes such as the sucking, palm-chin and biting reflexes, indicate neurological disorders that can have direct repercussions on the effectiveness of swallowing. Particular attention should be paid to the assessment of saliva production and oro-dental condition. The examination is continued using trials with different viscosities (liquids, semiliquids, semisolids, solids) according to different clinical bedside methods [2, 41].

Oxygen desaturation during feeding may be relevant to aspiration in dysphagic patients and this test is more useful in combination with other clinical assessments [42].

Instrumental assessment

Videofluoroscopic swallowing study (VFSS; modified barium swallow), fiberoptic endoscopic evaluation of swallowing (FEES) and pharyngoesophageal manometry are currently used to estimate swallowing dysfunction; these tools offer objective measurements of timing [43, 44], pressure [45, 46], range [47, 48] and strength [49, 50] of movements of the swallowing structures, bolus progression and clearance [51, 52], sensation [53, 54] and airway protection [55]. VFSS is the gold standard [2, 56].

VFSS is a dynamic exploration that evaluates the safety and efficacy of deglutition, characterizes its alterations, and helps to select therapeutic strategies. Technical requirements forVFSS are an X-ray tube with fluoroscopy and videotape recorder. Main observations during VFSS are done in the lateral plane while swallowing 3–20 mL boluses of at least three consistencies [57].

Several studies showed that FEES is equal to or even better than VFSS in detecting aspiration and severity of residues [58]. FEES has the advantages that it can be performed at bedside, is repeatable, evaluates motor and sensory components and assesses airway protection [59]. FEES allows direct visualization of pharyngeal and laryngeal structures and their function before and after swallowing [60]. During FEES, subjects are seated upright and have to swallow the bolus after it has been accurately delivered by syringe in the oral cavity. Three consistencies are administered (thin liquid, thick liquid and solid).

Both instrumental examinations are valuable. It is likely that both will continue to be used as complementary rather than competitors [61].

Pharyngoesophageal manometry records changes in pressure in the pharynx during passage of the bolus; it is justified when videofluoroscopy shows impaired opening of the upper esophageal sphincter [38].

Complications

Presbiphagia may give rise to clinical complications, such as malnutrition and/or dehydration (25–75 %) and aspiration pneumonia (50 %) [1, 2].

Nutritional status must be assessed and monitored, and specific dietetic strategies introduced to guarantee appropriate hydro-caloric intake. The European Council on food and nutritional care in hospitals identified functional oropharyngeal-dysphagia as a major contributor to malnutrition, asserting that undernutrition among hospital patients leads to extended hospital stays, prolonged rehabilitation and unnecessary health care costs [62]. The risk of aspiration pneumonia is also higher [63]. In elderly nursing home residents with OD, aspiration pneumonia occurs in 43–50 % during the first year, with a mortality of up to 45 % [56]. The pathogenesis of aspiration pneumonia presumes the contribution of risk factors that alter swallowing function, cause aspiration and predispose the oropharynx to bacterial colonization. Impairment in host defenses such as abnormal cough reflex [64], impaired pharyngeal clearance [65], amount and bacterial concentration of aspirate, weakened immune system, poor oral hygiene, also strongly contribute [66].

Treatment

The multidisciplinary team should plan an individualized treatment.

Conventional dysphagia therapy

Treatment can be compensatory, rehabilitative, or a combination of the two. Compensatory interventions aim at reducing the effects of impaired bolus flow, while rehabilitative interventions are designed to directly improve dysphagia.

Postural adjustments

Postural adjustments can reduce misdirection of bolus flow through biomechanical adjustment; they are relatively simple and require little effort. Eating in upright posture (90° seated) is a general rule for safe swallowing [23]; maintaining this position for at least 30 min after the end of the meal is recommended.

Examples of postural adjustments are tucking chin towards the chest [14] or, for patients with hemiparesis, turning head toward the hemiparetic side, effectively closing off that side to bolus entry and facilitating bolus transit through the nonparetic pharyngeal channel.

Food and liquid rate and amounts

Eating an adequate amount of food becomes a challenge both because of the increased time required to complete meals and because of fatigue. The following recommendations are useful [23]:

- eat slowly;
- do not eat or drink when rushed or tired;
- take small amounts of food or liquid into the mouth;
- concentrate on swallowing, eliminating any distractions;
- avoid mixing food and liquid in the same mouthful (single textures are easier to swallow than multiple textures);
- place the food in the stronger side of the mouth if unilateral weakness is present;
- facilitate cohesive bolus formation using sauces and condiments.

Diet modification

One of the mainstays of compensatory intervention is modifying the consistency of solid food and/or liquids [14]. Increasing the viscosity of liquids using thickener additives decreases the rate of flow, allowing patients more time to initiate airway protection [23]; thickened liquids are often used in hospitals and long-term facilities but frequently they are not well-accepted, so it is important to consider the risk of dehydration. Homogeneous, cohesive and pudding like food is suggested in patients with chewing difficulties [14], instead of solids.

One of the important decisions in management of the patient with disordered feeding is whether to work directly, attempting to reinforce the appropriate behaviour, or indirectly on swallowing, using exercises to improve neuromotor controls [67].

Oral hygiene

Poor oral hygiene can increase the likelihood of infection. Therefore, daily oral hygiene and periodic dental examinations should be encouraged [23].

Swallow rehabilitation

Swallowing rehabilitation consists of exercises targeted to train specific muscles or muscle groups [4, 67, 68]. Much of today's current treatments are centred on strength alone, with little evidence-based research documenting the benefits of therapeutic exercises. Clinicians still face the challenge of developing appropriate research-based strength training programs that meet unique criteria for a variety of patients.

The most commonly used exercise programs include effortful training, super- and supra-glottic maneuvers, Masako, Mendelson and the Shaker's exercises and the McNeill Dysphagia Therapy Program.

The effortful swallow therapy aims at increasing tongue base retraction and pressure during pharyngeal phase, and to reduce food residue in the valleculae. Effortful swallows performed by healthy normal adults showed significantly higher oral pressures, diminished oral residue, longer laryngeal vestibule closure and extent of hyoid elevation [69] as well as longer pharyngeal pressure duration and upper esophageal sphincter (UES) relaxation duration [70]. It is most indicated for people with residue after swallowing, and consists in a normal swallowing action during which the subject has to squeeze very hard with tongue and throat muscles. Ideally, excess effort should be visible by an external observer.

The super- and supra-glottic maneuvers aim at closing the airways at the vocal fold level before and during swallow [71, 72]. They increase tongue base retraction and pressure generation, and clear residue after the swallow. It consists of repeated swallowing performed while holding breath tightly. Each action is immediately followed by cough or throat clearing. Videofluoroscopic and videoendoscopic evaluations have demonstrated that airway closure duration is prolonged during both the supra-glottic and

super-glottic maneuvers [73, 74]. This training is indicated in persons with airway penetration after swallowing due to reduced laryngeal airway closure, reduced tongue base retraction and reduced laryngeal elevation. A limitation to its use is the blood pressure increase caused by the maneuver.

The "tongue hold exercise" (Masako method) aims at increasing tongue base and throat muscles range of motion, thus enhancing posterior pharyngeal wall movements. It consists of swallowing exercises while having the tongue protruded. It most benefits persons with tongue base and/or pharyngeal wall movement impairment. Contact between the tongue base and posterior pharyngeal wall is important for applying pressure on the bolus, to aid in transport through the pharynx [75]. It is one of the few exercises to be executed only with liquids or saliva, since the maneuver also results in increased pharyngeal residue and reduced laryngeal vestibule closure.

The Mendelsohn maneuver aims at augmenting the extent and duration of laryngeal elevation, and consequently increasing the duration of cricopharyngeal opening [76].

It consists of a voluntary prolongation of laryngeal excursion at the midpoint of the swallow. The subjects are instructed to place his/her finger on the Adam's apple and to squeeze throat muscles as much as possible when the Adam's apple reaches its highest position during swallowing. It can be practiced with or without food. It increases the duration of anterior–superior excursion of the larynx and hyoid, and consequently prolongs cricopharyngeal opening [77].

Shaker exercises are a set of repetitive head raisings aiming at building strength in the suprahyoid musculature, thus enhancing hyoid and laryngeal elevation [78]. Reinforcement of these muscles permits longer and wider opening of the upper esophagus sphincter.

Nonetheless, therapeutic exercise for dysphagia suffers a strong bias towards presumption of weakness, with a focus on strength training. These types of exercises do not usually replicate desired task, and largely lack a functional significance. In addition, motor repetition alone does not contribute to motor recovery, especially when impaired motor performance was baseline.

The McNeill Dysphagia Therapy Program was developed to overcome this limitation [79]. It is a systematic exercise-based therapy framework for the treatment of dysphagia in adults, based on progressive strengthening and coordination of swallowing in the context of functional swallow activities. It uses the act of swallowing as an exercise incorporating a single swallowing technique (hard swallow) and a specific hierarchy of feeding tasks. In a case–control study [80] the McNeill Dysphagia Therapy Program resulted in superior outcomes compared with traditional dysphagia therapy supplemented with sEMG biofeedback. These results were further supported by another study [81] reporting a tendency towards normalization of temporal coordination of swallowing components after therapy.

Other approaches

Chemodenervation

Chemical myotomy of the cricopharyngeal (CP) muscle by botulinum neurotoxin type A (BoNT/A) showed to be effective to treat neurological dysphagia in any disease with CP muscle dysfunction. BoNT/A causes muscle flaccidity by inhibiting the release of acetylcholine from the nerve endings. The injection of BoNT/A reduces its upper esophageal sphincter (UES) tonic and active contraction [82, 83]. The advantage of BoNT/A is that it can be performed in outpatient clinics, needing neither hospitalization nor general anesthesia. It can be repeated, retains the same efficacy and requires no specific follow-up. However, this treatment may have potential risks. The diffusion of BoNT/A into the nearby laryngeal muscles might lead to laryngeal muscle weakness/paralysis or to worsening of the preexisting dysphagia. For this reason, treatment must be performed under electromyographic guidance by an expert operator [84].

Pharmacological treatment

Drugs can be prescribed to treat symptomatic dysphagia, especially when the cause is related to lower esophagus pathologies. This is not usually the case for presbyphagia. Nonetheless, subjects can present with a combination of both, prompting treatment. Among the most commonly prescribed drugs, calcium channel antagonists are used to reduce excessive esophageal contractions in cases of hypertensive peristalsis or diffuse esophageal spasms [85]. A trial has been conducted in post-stroke subjects, with positive results [86]. The rational lays in the smooth muscle relaxing properties of calcium channel antagonists.

The use of glucagon, previously used as i.v. infusion in cases of bolus impaction in the esophagus, has been disconfirmed by a recent best evidence report [87]. Glucagon may induce vomiting which is undesirable in any distal esophageal impaction due to the risk of perforation.

Other rare drug regimens include nitrates (e.g. isosorbide dinitrate), which acts through the smooth muscle myorelaxant effect of nitric oxide and is mainly prescribed in achalasia [88, 89], corticosteroids in cases of eosinophilic esophagitis [90] or cystine-depleting therapy with cysteamine in dysphagia due to pretransplantation or posttransplantation cystinosis [91].

The use of anti-microbial agents as a means to reduce the colonization of pathogenic organisms in portions of the digestive tract has also been studied. Selective decontamination of the digestive tract (SDD) has been investigated in a critical care setting requiring artificial ventilation, where it reduces nosocomial infections and mortality [92]. SDD applied only as a topical gel rather than as a systemic therapy [93] was positively associated with reductions in the incidence of pneumonia in post-stroke subjects. Although no adverse events were reported, it remains to be established if the treatment is cost-effective.

NMES (neuromuscular electrical stimulation)

Neuromuscular electrical stimulation (NMES) has been used to treatment dysphagia [94, 95]. Anterior neck muscles are stimulated to obtain muscle contraction. Longitudinal studies involving stroke patients confirmed deglutition-related cortical changes and reorganization. Several studies investigated the effects exerted by NMES on the cerebral representation of swallowing, reporting positive results on cortical excitability or reorganization [96, 97].

Due to different stimulation protocols and the various underlying pathological conditions, a comparison of the current literature is difficult. Spontaneous recovery may have occurred in patients treated with NMES. It appears reasonable to assume that NMES can modulate swallowing directly and/or by interfering with control and execution mechanisms; in combination with traditional therapy may offer better results [98].

Non-invasive brain stimulation techniques

Repetitive transcranial magnetic stimulation (rTMS) and transcranial direct current stimulation (tDCS) have emerged as potentially beneficial neuromodulatory techniques for the rehabilitation of communication and swallowing disorders.

rTMS (repetitive transcranial magnetic stimulation)

rTMS has been used in stroke patients, based on the hemispheric imbalance hypothesis [99, 100]. Although few studies reported its effectiveness, the application of rTMS on dysphagia appears promising [101].

tDCS (transcranial direct current stimulation)

tDCS is a relatively new, non-invasive brain stimulation modality in which a small direct current is applied via scalp electrodes to polarize neurones [102, 103]. Data from the stroke literature suggest that tDCS may have a role in expediting recovery of motor behaviour and procedural learning [99], acting on the inter-hemispheric rebalancing of the motor cortex after stroke. tDCS has advantages compared to other neurostimulation-based treatments trialled in dysphagia rehabilitation: it is portable, easy to use, low cost and less invasive. These points make tDCS an attractive option for delivery at the bedside. Few studies suggest that tDCS can play a role in swallow recovery after stroke, but stimulation sites, parameters, optimal number of sessions remain to be defined [104].

Discussion

Dysphagia is a main disturbance in the ageing population. In this group dysphagia occurs because of swallowing physiology changes due to advancing age (presbyphagia), or because of increased prevalence with ageing of diseases that alter the swallowing process.

Since the prevalence of dysphagia is expected to increase rapidly in the near future, it is important to recognize it as a national health care issue and to ensure the best practice in the field.

Currently, no specific guidelines regarding presbyphagia management and treatment exist. The Stroke Prevention and Educational Awareness Diffusion (SPREAD) Italian Stroke Guidelines focussed on screening, diagnosis and rehabilitative strategies in post-stroke dysphagia [105]. The Italian Federation of Speech and Language Therapists (FLI) guidelines [106] focussed mainly on diagnosis and evaluation of dysphagia in adults, with little mention of rehabilitation.

Based on the lack of up-to-date guidelines, we aimed at increasing awareness of the risk of dysphagia in the elderly. Recommendations on screening procedures, clinical evaluation and instrumental assessments were provided, and different therapeutic strategies were suggested as follows. Dysphagia symptoms should be considered by physicians in all elderly patients to prevent complications and improve patients' quality of life.

- Dysphagia management should be a multidisciplinary team effort, and should be based on careful history taking, appropriate screening, clinical and instrumental evaluation; it should aim at defining the patient's impairments and residual abilities to individualize therapeutic strategies.
- Screening evaluations should be performed in all institutionalized elderly patients; early identification of dysphagia and aspiration risk is critical to avoid adverse health consequences in these frail subjects.
- Screening tests should be administered by trained nursing staff or speech-and-language therapists. They should be low risk, quick and low cost, and aim at

selecting the highest risk patients who require further assessment.
- Further clinical and instrumental assessments can be necessary to rule out aspiration with an acceptable level of confidence in selected patients.
- Institutionalized patients with dysphagia generally benefit from compensatory strategies such as oral hygiene, diet modifications and postural adjustments; since they are often dependent on others for feeding and personal care, caregivers' training will be crucial.
- Systematic exercise-based therapy frameworks should be developed for the treatment of dysphagia in adults, shifting the focus of rehabilitation from strength-reinforcing exercises to a more comprehensive and functional training.
- Subjects with dysphagia due to acute stroke may benefit from an exercise-based swallow rehabilitation alone, or in combination with other approaches (e.g. tDCS, rTMS, NMES).
- Subjects with cricopharyngeal muscle dysfunction may benefit from BoNT/A injections in addition to conventional dysphagia therapy. Polypharmacy in the elderly is a frequent practice as the incidence of poly pathology increases with age; difficulty in swallowing pills can be the first sign of dysphagia; in the most severe cases, oral drugs should be replaced with an alternative method of administration to guarantee the efficacy of the therapy.

Conclusions

Physicians should identify patients at risk with the aim of preventing complications, reducing hospital length and costs; rehabilitative strategies should be individualized. Health workers and caregivers' education and training are critical and should be included in the global management.

Compliance with ethical standards

Conflict of interest All the authors declare that they have no conflict of interest.

Ethical approval This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent For this type of study formal consent is not required.

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