

Swallowing function in advanced age

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Purpose of review

To present current literature regarding swallowing function in advanced age, including healthy ageing, dysphagia and trends in multidisciplinary team service delivery.

Recent findings

Normative studies support swallowing efficiency but greater variability in healthy advanced age, through to 100 years old. Deviations from normative data and symptoms of dysphagia leading to aspiration or nutritional risk, imply swallowing disorder, rather than simply the ageing process. Quantitative and qualitative studies are emerging that promote management of swallow dysfunction for an ageing society, including innovative assessment, home treatment, swallowing exercise and optimized mealtimes.

Summary

Current literature on swallowing function in advanced age provides multidisciplinary perspectives and initiatives, with clear commitment to improving quality of life for older adults. The diversity of the older population and serious consequences of swallowing difficulties calls for routine screening tools for swallowing impairment and malnutrition risk. Representation of 'oldest old' in future normative studies is essential to guide swallowing management in adults over 85 years old.

Keywords

dysphagia, elderly, malnutrition, older adults, swallowing

INTRODUCTION

'Elderly' has traditionally featured in the literature to classify adults 65 years and older [1,2]. In more recent years, this classification has evolved to differentiate 'young old' (65–74 years of age) from 'old old' (75–84 years of age) and 'oldest old' (85 years and older) [3]. Recognition of the globally ageing population is reflected in the growing interest in ageing research, including deglutition. Terminology referring to age-related swallowing changes has gained traction in the deglutition literature, such as presbyphagia [4], senescent swallowing [5] and sarcopenic dysphagia [6]. The spotlight on increased prevalence of dysphagia in older adults due to increased dysphagia-associated diagnoses, comorbidities and medications, calls for clinical research and improvements in dysphagia management catering to advanced age [7]. Understanding healthy swallowing variability across the lifespan prevents attributing symptoms of swallowing impairment as part of the typical ageing process or conversely, over-managing patients [8,9]. This review presents current evidence and opinion in the literature (January 2017–June 2018) regarding swallowing function in advanced age from a perspective of both healthy ageing and pathology, as well as trends in multidisciplinary practice.

SWALLOWING IN OLD AGE

The term presbyphagia has appeared throughout the recent deglutition literature but remains to be fully defined [10,11]. Over-generalization of the ageing process and its effects on swallowing, risks becoming misleading, as maintenance of swallowing efficiency is generally established in healthy 'old' and 'oldest old' adults [8]. Therefore, reports of swallowing problems should receive appropriate attention and investigation, rather than be attributed to a natural consequence of gradual ageing. Normative studies assist with understanding healthy age-related changes, but the heterogeneity of the older population complicates recruitment, most evident in the imbalance of 'oldest old' in the deglutition literature. However, with increased

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Curr Opin Otolaryngol Head Neck Surg 2018, 26:367–374

DOI:10.1097/MOO.0000000000000485

KEY POINTS

- Swallowing efficiency can be maintained in healthy advanced age.
- Dysphagia is not a symptom of age; swallowing complaints are not age-related.
- Representation from 85+ year olds is warranted in future studies.
- Dysphagia risk and malnutrition risk should be routinely screened in hospital and residential care facilities.

focus on the globally ageing population, quality studies are emerging.

Oral phase of swallowing

Unlike the pharynx, age-related changes in the oral cavity can be visualized without instrumental assessment. In a recent review, Peyron *et al.* [12] correlate changes in saliva, dentition and oral motor skills with age, which accordingly, are considered central to oral phase assessment. Rogus-Pulia *et al.* [13] highlight the crucial role of saliva during bolus preparation, associating age with perceived dry mouth and not swallowing effort, which perhaps warrants the development of treatments for xerostomia in the older population. Insufficient chewing is identified by Kim and Kim [14] as a predictor for poor oral intake and compromised nutrition in older age, rather than number of teeth. Therefore, older adults with chewing difficulties may benefit from a modified diet. However, this is not a blanket recommendation, as unnecessarily modified diets may lead to malnutrition, reduced muscle mass [15] and psychosocial consequences [16]. This issue inspired Wada *et al.* [17] to develop a simple and practical bolus preparatory assessment: colour-changeable chewing gum. There is need for more innovative swallowing assessment tools beyond the clinical environment to enhance access for the ageing community.

Pharyngeal phase of swallowing

Namasivayam-MacDonald *et al.* [18^{**}] systematically reviewed the literature on timing measures of swallowing in healthy elderly through videofluoroscopic swallowing studies (VFSS). The authors summarize consistently reported timing differences: longer times in older adults for swallow reaction parameters, pharyngeal delay and UES opening, and shorter times in older adults from bolus entry into the pharynx to epiglottic deflection [18^{**}]. Above all, age does not appear to affect velocity of bolus transit or the

majority of timing parameters in swallowing. Varied terminology for swallowing parameters are categorized in tables, whereas timing measures between younger and older adults are compared in striking forest plots. Namasivayam-MacDonald *et al.* support a larger range of normal variation in swallowing measures with age, calling for age-matched controls to enhance dysphagia management for older adults. They conclude that large deviations from age-matched norms are attributable to symptoms of swallowing impairment rather than age [18^{**}].

Limitations that burden normative swallow studies include low participant numbers, small bolus sizes or range of liquid types, and the impact of spoon delivery, barium and cued swallows [19[■]]. Herzberg *et al.* [20] present an update on swallow event sequencing in older adults, comparing older ($n=23$, 65–90 years old) to younger ($n=20$, 22–45 years old) cohorts, with well presented data that eases interpretation of complex analyses. The authors report reduced variation in overall swallow sequences with age, which contrasts with increased variability of timing measures. Specific findings diverge from Kendall *et al.*'s original study [21], which comprised a younger (18–62 years old), yet larger sample size ($n=60$). Herzberg *et al.* results claim to serve as a normative reference for the dysphagia population, despite the small sample size. This recent study also demonstrates the challenge of recruiting an older cohort with representation from the 'oldest old'.

In our laboratory, we recruited 139 healthy adults aged 20–99 years old (including 34 adults aged 80 years and older, $M=86.6$, $SD=5.9$), who underwent VFSS. Quantitative analyses of timing and displacement measures devised by Leonard and Kendall [22] have been performed. Early results reflect previous studies of age-related swallowing changes between dichotomous younger (<65 years old) and older age groups (e.g., increased pharyngeal transit times, pharyngoesophageal segment (PES) opening duration, pharyngeal constriction ratio and reduced PES maximal opening distance seen in older adults). However, further differentiation between 'old' and 'oldest old' groups suggests healthy age-related changes are not progressive and swallowing efficiency is maintained up to 100 years old (Fig. 1). Structural changes, such as cricopharyngeal bars (16% of >70 years old) and osteophytes (23% of >70 years old) were observed significantly more often in older asymptomatic individuals, suggesting these changes may not always be a source of deficit.

Oesophageal phase of swallowing

The pharyngoesophageal relationship is well recognized. However, it remains the clinical norm to



FIGURE 1. Lateral videofluoroscopic image demonstrating minimal residue of paste following swallow of a 5 ml paste bolus in a healthy 80 years old.

perform separate pharyngeal and oesophageal studies, which Levine and Rubesin [23] emphasize 'needs to end' in a historical narrative of the barium swallow (p. 61). Our laboratory team are strong proponents of oesophageal screening as an adjunct to VFSS. We previously reported a significant increase in oesophageal transit times for a 20 ml liquid barium bolus with age (Fig. 2) [24]. Of further clinical relevance, there was no age association with pill and paste oesophageal transit times, or with the occurrence, location and frequency of bolus stasis. In the recent literature, the oesophageal phase has received little attention. However, one paper from Cock *et al.* [25] reports novel findings for adults 80 years and older from high-resolution manometry, including reduced relaxation and bolus flow at the oesophagogastric junction.

Penetration and aspiration

Last year, Butler *et al.* [19^a] added to their normative series on Functional Endoscopic Evaluation of Swallowing (FEES). This time, the authors investigated factors associated with penetration and aspiration in 203 healthy participants through to 90 years old. Penetration was detected on 9% of swallows, and aspiration on 2% of swallows across the lifespan, of which 75% were silent (Penetration–Aspiration Scale (PAS) 8: no effort to eject material in airway) [26]. PAS ratings between younger and older age groups suggested an age effect. This also corroborates preliminary research in our own laboratory, where only three airway violation events were detected out of 139 swallows of 20 ml: aspiration of postswallow residue in an 88 year old (PAS 6) and 95 year old (PAS 4); and intra-deglutitive



FIGURE 2. Anterior–posterior videofluoroscopic image demonstrating oesophageal transit of 20 ml liquid barium bolus in a healthy 87 years old.

penetration in a 90 year old (PAS 3, Fig. 3). As penetration and aspiration events are often perceived as more severe during FEES [27], this may account for differences in PAS ratings and frequencies between studies using FEES versus VFSS.

DYSPHAGIA AND AGEING

Emphasis on increasing prevalence of swallowing complaints due to the globally ageing population features as a basis for many studies. However, does this risk portray swallowing deterioration as a feature of age, or a discreet symptom of an underlying disease/disorder? Of further concern, older adults with difficulties swallowing may attribute their symptoms to the ageing process and not complain of swallowing problems, assuming they cannot be helped. Instead, older adults may try to adapt or curtail their diet, leading to delayed management and worse consequences [28]. de Lima Alvarenga *et al.* [29] interviewed and performed FEES on 100 healthy over 60 years old, finding no relationship between subjective symptoms and clinical observations. Furthermore, 'ageing itself was not an isolated risk factor for dysphagia' (p. 447). This reflects an

earlier epidemiological study, which profiled increased rates of dysphagia referrals in advanced age, yet reminded the clinician that 'ageing per se does not cause dysphagia' [30] (p. 714). In a recent systematic review, Zhao *et al.* [31] highlight that although sarcopenia increases with age, it is unknown whether sarcopenia causes dysphagia.

Prevalence of dysphagia

Quantifying dysphagia prevalence is an ongoing challenge that needs more attention, well beyond a static percentage. The lack of robust data on prevalence is a pitfall for recent reviews, with reliance on data from questionable methodologies [32]. In contrast, the Eating-Assessment Tool-10 (EAT-10) was validated for documenting dysphagia severity; a score of 3 or higher is considered abnormal [33]. Wham *et al.* [34] used the EAT-10 to offer a fresh perspective on dysphagia risk prevalence in the older population across community, hospital and residential care facilities. The authors found 17% of 167 participants at risk of dysphagia: 4% of older adults in the community; 16% of older adults in hospital and 32% of older adults in residential care



FIGURE 3. Lateral videofluoroscopic image demonstrating penetration on 20 ml thin fluid in a healthy 90 years old.

[34]. This supports calls to incorporate dysphagia screening for those transitioning from independent living to supported living facilities.

Malnutrition

There is building evidence to support the routine screening of nutrition and dysphagia in the older population. In recently hospitalized patients aged 85 years and older ($n=88$), Popman *et al.* [35^a] identified one-third with malnutrition and dysphagia risk, whereas 43% were at risk of malnutrition. For older adults receiving enteral nutrition in a stroke rehabilitation ward, Nishioka *et al.* [36] noted that an even higher proportion of older patients (93%) were at risk of malnutrition, yet age was not correlated with achieving full oral intake. In long-term care residents aged 65 years and older, Namasivayam-MacDonald *et al.* [37] classified 44% as malnourished and 59% with suspected swallow impairment. Edwards [38^a] explored 'what next' after dietary recommendations are made, by systematically appraising environmental reasons contributing to malnutrition risk in hospital and

rehabilitation patients over 65 years old. Inadequate feeding assistance is associated with poor mealtime outcomes. The author suggests a number of initiatives to enhance mealtimes: set up meals that are within reach with opened packaging; allow adequate time to finish meals; promote positive interactions in communal dining rooms and involve volunteers, employed assistants and family [38^a]. Preventive action to maintain good nutrition in advanced age is underway [34,35^a].

Aspiration pneumonia

Although aspiration pneumonia can be a life-threatening illness for older adults, studies indicate that ageing alone is not a risk factor. For adults in residential care, Hollaar *et al.* [39] correlated pneumonia with dysphagia and not age. During hospitalization, Kenzaka *et al.* [40] recognized that swallowing function assessment, consciousness and extent of infiltration on chest radiography were significant predictors for the discontinuation of oral intake due to recurrent aspiration. Similarly, in older patients with acute pneumonia, Oba *et al.* [41] identified the Glasgow

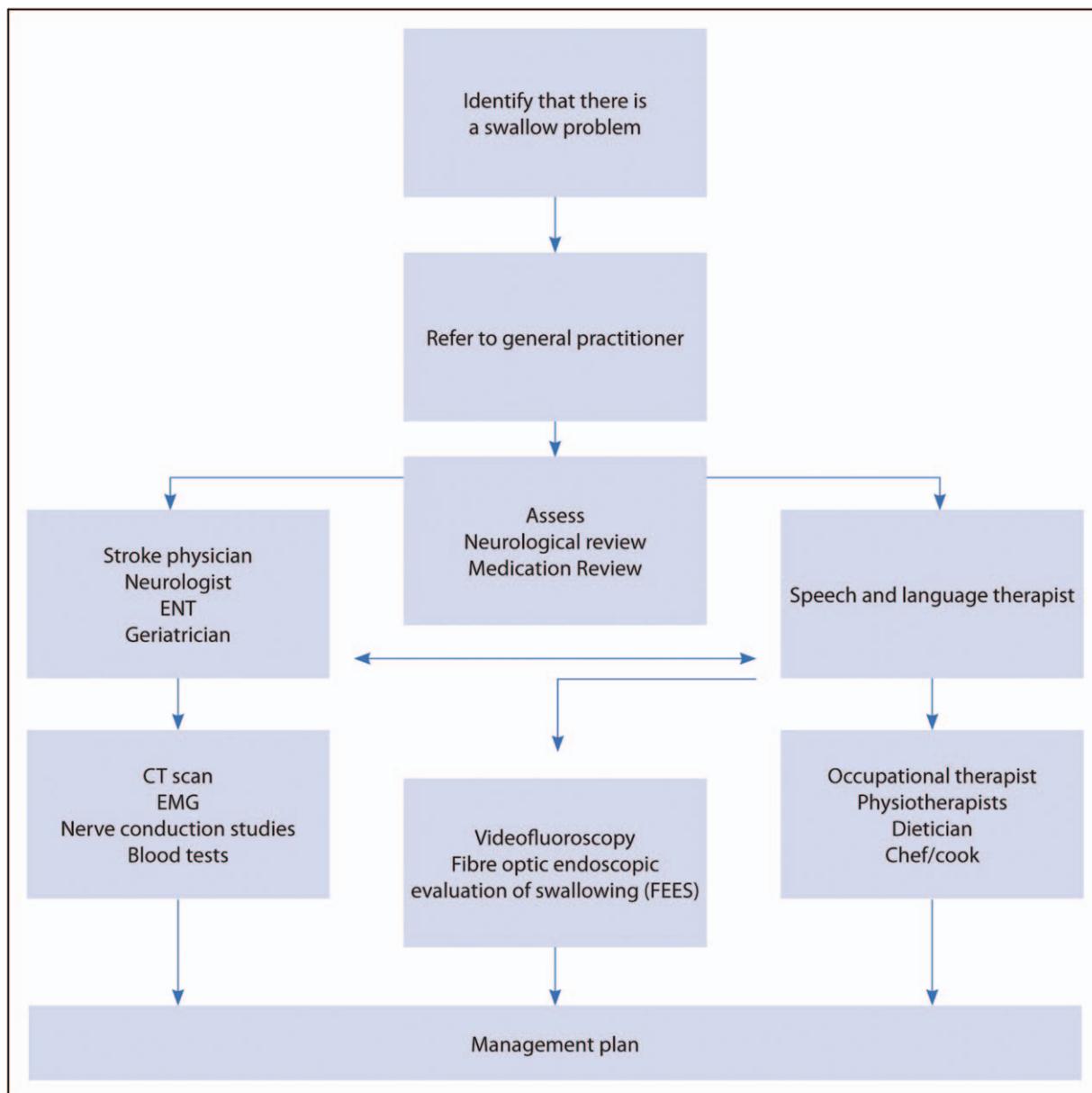


FIGURE 4. Multidisciplinary management for older adults with swallowing problems [42^a].

Coma Scale and Repetitive Swallowing Test as prognostic predictors for oral intake, not age.

TREATING PRESBYPHAGIA

Smithard [42^a] offers a thorough clinical perspective on supporting older adults with eating and drinking, particularly those who are very frail. Figure 4 presents a multidisciplinary pathway for the management of older adults with swallowing problems, devised by Smithard. The author forecasts areas of future research for frail older adults such as 'maintenance' swallowing rehabilitation exercises working on the principle of 'use' it or 'lose it'. Molfenter *et al.* [43] report the effects of swallowing exercise in

healthy older adults, targeted at improving pharyngeal musculature that may be at risk of atrophy with age. Although PAS scores were unchanged, maladaptive effects were observed from the effortful swallowing task. Perhaps this suggests that natural compensations in the ageing process came under threat due to forced reinvention of a typical older swallow. We have explored the wider effects of intensive voice therapy, Lee Silverman Voice Treatment (LSVT), in adults with Parkinson's disease and no swallowing complaints [44]. Alongside expected voice improvements, we observed increased maximal opening distance and duration of opening of the PES, as well as improved pharyngeal tone [44]. These parameters contribute to swallowing

efficiency and complete bolus transit while reducing residue (a recognized risk for aspiration). Studies regarding general 'use it or lose it' physical activity interventions are well documented to improve physical functioning outcomes for older adults [45]. There may be promise for general swallowing exercises but further investigation is required.

Long-term management of dysphagia

It is well known that multidisciplinary teamwork optimizes dysphagia management [42[▪]]. In cases of profound swallowing impairment, the decision for risk feeding versus alternative feeding is complex and an ethical dilemma, particularly in advanced age. The need for risk-feeding guidelines is promoted in New Zealand research. A retrospective hospital audit highlights varied management and lack of documentation regarding feeding decision-making [46]. This corresponds with perceptions of staff, patient, and family in a qualitative study of complex feeding decisions in an inpatient setting. Themes include inadequate training and operational policy around complex feeding, communication, the complexity of the decision, and patient and family-centred care [47]. For enteral feeding in older adults, a similar specialized team approach is essential to establish, monitor and discontinue feeding [48]. In a systematic review, Lan *et al.* [48] recognize contradictions for alternative feeding in adults 65 years and older with varied comorbidities: neither is nutritional status necessarily improved, nor weight loss prevented. Ultimately, oral intake is recommended to uphold quality of life. However, texture-modified diets can also have repercussions, as Seshadri *et al.* [16] discuss in a thought-provoking qualitative study. Themes such as continuum of adherence and preservation of self-identity offer important talking-points. As eating plays a central role in enjoyment for older adults, it is no surprise that Morisaki *et al.* [49] correlate increased dysphagia risk with decreased quality of life scores for older dependent adults in the community. The authors promote the development of home interventions to better support older dependent adults with or at risk of swallow dysfunction, living in the community.

CONCLUSION

Today's adults in their early sixties may no longer meet criteria for 'elderly' as their former counterparts did, especially those working beyond retirement years and living well. Connotations of 'elderly' may instil expectations of swallowing changes and infirmity based on age alone. Current research addresses this misconception - symptoms

of dysphagia are not characteristics of healthy ageing. The diversity of the older population and serious consequences of swallowing difficulties call for routine screening tools for evaluation of swallowing impairment and malnutrition risk to be instituted. Multidisciplinary perspectives and initiatives beyond the clinical environment demonstrate a clear commitment to improving quality of life for the ageing population.

Acknowledgements

We would like to thank Dr David Smithard for permitting the use of his management pathway for older adults with swallowing problems (Fig. 4).

Financial support and sponsorship

M.J. would like to acknowledge the support from the HOPE Selwyn Foundation.

Conflicts of interest

The authors report no conflicts of interest.

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