Hot topic in geriatric medicine

Oropharyngeal dysphagia in older adults: A review

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A B S T R A C T

Oropharyngeal dysphagia is an underestimated symptom in geriatric population. Neurological and neuromuscular diseases, but also structural causes and iatrogenesis are its main and more frequent causes. This symptom should not be neglected, as it may significantly impair the swallowing process and therefore cause malnutrition, dehydration and even worse lead to aspiration pneumonia. Clinical presentation is often insidious and dysphagia’s symptoms are seldom mentioned by elderly patients. Bedside screening methods could help select the patients needing through instrumental testing, in order to confirm oropharyngeal dysphagia. Subsequently, a multidisciplinary comprehensive assessment could lead to personalized therapeutic interventions, according to the patient’s particularities and wishes.

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1. Introduction

Normal swallowing is a complex and well-coordinated process with two essential and vital functions: bolus transport and airway protection. It needs an optimal interplay between breathing and swallowing to ensure the patient’s safety and to avoid potential complications, especially in older patients. Dysphagia is defined as the difficulty or impossibility to swallow liquids, food or medication and can occur during the oropharyngeal or the esophageal phase of swallowing. In older population, dysphagia has a significant impact on deglutition efficacy and safety. Impairment in deglutition efficacy may cause malnutrition and/or dehydration while compromised safety increases the risk of aspiration pneumonia [1,2]. Eating and drinking are also social and pleasurable activities. Therefore, dysphagia has significant social and psychological consequences, including avoidance of public eating, anxiety or panic reactions during mealtimes [3].

Early recognition and appropriate management of dysphagia is an important feature in geriatric care. Symptoms associated with deglutition disorders in geriatric population are often neglected by the patients themselves. Patients fail to mention them to their physician as they consider them as a normal part of aging [4].

Also, physicians and caregivers often fail to identify such disorders, what surely underestimates their reported prevalence. Estimates of oropharyngeal dysphagia prevalence vary greatly, depending on the type of population and the screening methods used. Thus, it is difficult to obtain precise data on prevalence of dysphagia in older adults. For example, in the primary care setting, 13–35% of adult patients living independently report dysphagia when assessed by self-administrated questionnaires, and especially the older patients. The same patients seldom mention it when visiting their physician [4,5]. The prevalence of dysphagia can reach over 50% in hospitalized patients with acute illnesses, e.g. stroke or head and neck cancers, or in nursing home residents aged 65 and older [6–8]. For example, in a recent systematic review about dysphagia after stroke, the mean age of patients varied between 70 and 75 years and the reported incidence of dysphagia ranged from 37% to 78% [7]. In a large study on hospitalized patients admitted for disorders other than dysphagia in the United States, using data from the National Hospital Discharge Survey (NHSD), considering all age groups, patients with dysphagia had a 40.6% increase in median length of hospital stay. In the age group 75 years or older, the rate of dysphagia was 73%, more than twice the average rate for all age groups. Dysphagia was also associated with a substantially increase in mortality [9].

This article will review modifications of swallowing with normal aging, current evidence related to oropharyngeal dysphagia in respect to its physiopathology, clinical facts, etiologies, diagnostic and therapeutic options.

2. Physiology of deglutition

The upper aerodigestive tract has two main functions through a unique anatomic pathway: breathing and swallowing. Coordinated interaction between swallowing and breathing is essential to guarantee deglutition’s safety and efficacy.

Deglutition is a complex process implicating many interacting sensory, motor and psychological components. Normal swallowing involves facial, palatal, suprahypoid and pharyngeal structures and requires intact function of specific cranial nerves (V, VII, IX, X,
XI and XII), cortical, brainstem and cerebellar [10,11] control centers.

Deglutition can be separated in three sequential phases: oral, pharyngeal and esophageal phase [11,12].

The oral phase involves both voluntary and reflex actions, controlled by cortical and brainstem areas. The oral preparatory phase helps to transform food to a homogenous bolus, ready for transport. Food is chewed, crushed and mixed with saliva. A stable set of teeth, optimal lip closure and functional masticator muscles ensuring jaw closing and chewing are necessary. The bolus is then collected on the anterior tongue and directed toward the posterior portion of the oral cavity. During this propulsive oral phase, the lips are closed and the movements of jaws and tongue help to move the bolus by a voluntary action. The tongue movements stimulate oropharyngeal receptors, and so trigger the pharyngeal swallow reflex.

The pharyngeal phase is a reflex one. Before the bolus enters the oropharynx, the soft palate elevates to close the nasopharynx and avoid regurgitations through the nose. At the same time, the hyoid bone elevates and draws the larynx upwards while the epiglottis folds down to protect the larynx’s entrance. The tongue base moves in contact with the posterior pharyngeal wall, accompanied by an anterior movement of the hyoid, while the cricopharyngeus muscle begins its relaxation and the upper esophageal sphincter opens.

The esophageal phase starts after bolus passage through the upper esophageal sphincter and is characterized by peristaltic movements of the esophagus. After opening of the lower esophageal sphincter, the bolus is directed towards the stomach.

3. Effects of aging on swallowing

Age-related modifications of the swallowing process in otherwise healthy older adults, sometimes called "presbyphagia", rarely cause oropharyngeal dysphagia [13]. An increased risk for dysphagia may however occur in the presence of potential stress factors such as medications affecting the central nervous system.

Tongue activity is a crucial factor in both oral and pharyngeal phases of deglutition. Isometric tongue pressure is significantly decreased in healthy older people compared to younger subjects, whereas maximal lingual pressure during swallowing remains similar in both groups. Some authors consider that overall pressure reserves decline with age [14–16], implicating higher difficulties for older people to obtain adequate swallow pressures. Nevertheless, diminished tongue strength during swallowing with age remains a matter of debate [17].

Normal aging is also associated with reduced pharyngolarysteal sensory discrimination [18] and a higher threshold to trigger the pharyngeal phase [19,20].

Older adults recruit far more cortical regions during swallowing, suggesting that more cortical involvement is necessary to complete the same swallowing task [21–23]. Healthy older adults present with prolonged oropharyngeal phase with aging [24,25], delay before the onset of the pharyngeal swallow response and increased residues in the pharynx [10]. Consistently, the proportion of silent aspiration or penetration, assessed by flexible endoscopic evaluation of swallowing, is higher in older subjects [26]. Globally, oral transit time and upper esophageal sphincter relaxation are significantly longer in the elderly [15,25].

Swallowing disorders can cause food bolus, liquid or saliva input into the larynx. When the bolus moves below the level of the vocal cords, it is defined as pulmonary aspiration, and as penetration when the bolus remains above the glottis level. Aspiration or penetration without any subsequent cough or clinical evident symptom is defined as silent.

4. Common causes of oropharyngeal dysphagia in geriatric patients

4.1. Neurological diseases

Cerebrovascular disease is a common cause of dysphagia. A recent systematic review confirmed that the prevalence of dysphagia after stroke ranges from 37% to 78% [7]. These variations were attributed to the different detection methods used, the time after stroke and the stroke lesion location. The lowest incidence was obtained with swallowing screening tests, like water swallowing and the highest incidence was noticed with instrumental testing, e.g. video fluoroscopy. Stroke patients with dysphagia have a 3-times higher risk for pneumonia than those without dysphagia [7]. Therefore, systematic evaluation for deglutition disorders after stroke is important. Importantly, stroke patients have a worse outcome in terms of morality and length of hospital stay when dysphagia is present [27].

In Parkinson’s disease (PD), deglutition disorders can co-occur, precede or follow the classical motor signs onset [28,29]. Almost 90% of patients with PD present dysphagia during the course of the disease. Aspiration is a major cause of morbidity and mortality [30] and affects quality of life [31,32]. Drooling, persistent food residues, slow transit and repeated tongue movements can be observed during oral phase in patients with PD. Delayed triggering of the pharyngeal swallow, prolonged opening of the upper esophageal sphincter and vallecular stasis are also reported [31]. In less frequent extrapyramidal disorders (progressive supranuclear palsy, corticobasal degeneration, dementia with Lewy bodies and multiple system atrophy), deglutition may be severely impaired even at early stages of the disease.

Deglutition disorders usually occur in late stages of dementia, but may also be present at early or mid-stages of Alzheimer’s disease. They are often underestimated or neglected. All types of dementia, neurodegenerative or vascular, affect cortical regions involved in swallowing, and swallowing control can be impaired by concentration or selective attention deficits. A recent study suggested that in Alzheimer’s disease, brain areas underlying swallowing function show early compromise, probably before clinical dysphagia diagnosis [33]. Concerning vascular dementia, a recent observational study assessed the prevalence of 16 neurological signs, particularly dysphagia, in a large population of patients with vascular dementia. After exclusion of the patients with a history of stroke within the 3 months before baseline, up to 20% of this population showed impairment in deglutition [34].

Amyotrophic lateral sclerosis (ALS) may cause dysphagia, but is rare in a geriatric population. Up to 30% of patients with ALS present bulbar symptoms at onset of the disease and almost all patients develop such symptoms at later stages of the disease. Among bulbar symptoms, dysarthria and dysphagia remain the most common [35,36]. Weakness or spasticity of various muscles of the upper aerodigestive tract can impair the swallowing process. Aspiration pneumonia (AP) is a frequent complication in these patients and the most frequent cause of death [37,38].

Less frequent neurological causes of oropharyngeal dysphagia in the elderly are facial palsy, Guillain-Barré’s syndrome, multiple sclerosis, postpolio syndrome and Huntington’s disease.

4.2. Iatrogenic causes

Patients who underwent in the past intubation or tracheotomy, and patients with nasogastric feeding tubes may have impairment in the swallowing mechanism. After effects of surgery or radiation in the oropharyngeal region are also well-known iatrogenic causes of dysphagia.
Polypharmacy is a frequent finding in elderly people. Difficulties in swallowing pills may be an indicator of deglutition disorders. Dysphagia may also occur as an adverse effect of certain medications through various mechanisms [37,39]:

- Xerostomia or diminished salivary flow is a common side effect of many drugs, mainly through their anticholinergic effect. Several inhaled drugs (steroids, asthma medications, vasconstrictors or expectorants) can also cause xerostomia or oral candidiasis, and alter deglutition;
- Various drugs are known to depress the central nervous system, especially psychotropic agents like antidepressants, antianxiety agents, antipsychotic, sedative or hypnotic agents. This drug-induced sedation contributes considerably to deglutition disorders onset in the elderly. Furthermore, antipsychotics, beyond their sedative properties, may cause oropharyngeal dysphagia through their extra pyramidal effects and facial and mouth dyskinesias;
- In some cases, drugs may interact with swallowing by blocking neuromuscular junction (for example penicillamine or antibiotics like aminoglycosides and erythromycin);
- Corticosteroids or lipid lowering agents may affect deglutition by drug-induced myopathy.

Table 1 shows a long but non-exhaustive list of medications associated with oropharyngeal dysphagia. Dehydration can contribute to deglutition disorders in predisposed patients by inducing xerostomia or even stupor in extreme cases.

4.3. Structural causes

Cricopharyngeal bar, Zenker’s diverticulum, oropharyngeal tumors, gastroesophageal reflux disease, oropharyngeal candidosis or any extrinsic compression of the upper aerodigestive tract (tumors, osteophytes, skeletal abnormalities, enlarged lymph nodes or thyroid nodules) can be responsible of oropharyngeal dysphagia.

4.4. Other causes

When previous causes have been eliminated, less frequent diseases potentially responsible of dysphagia must be ruled out. They include neuromuscular diseases, like myasthenia gravis, paraneoplastic syndromes, inflammatory myopathies (dermatomyositis, polymyositis), toxic and metabolic (thyrotoxic) myopathies. Finally, various infectious (diphtheria, botulism, Lyme disease, syphilis, herpes) and metabolic disorders (amyloidosis, Cushing’s syndrome, Wilson’s disease) can cause dysphagia, but remain exceptional in old patients.

5. Complications of oropharyngeal dysphagia

Two types of potential severe complications must be considered in deglutition impairment: insufficient oral intake with resulting malnutrition and dehydration (efficacy) and increased risk for aspiration pneumonia (safety).

Consequences of swallowing disorders on the nutritional status are important to consider. Neurological dysphagia is known to increase hospital stay, post-stroke rehabilitation, morbidity and mortality but is also a major factor for malnutrition [40]. In elderly people, low energy and protein intake is significantly associated with frailty [41]. Indeed, patients with dysphagia in acute geriatric wards had worse functional status and higher prevalence of malnutrition [1].

Oropharyngeal dysphagia is a recognized risk factor for aspiration pneumonia (AP), but also an indicator of pneumonia severity and mortality [1]. The risk of AP increases with age. In a nursing home residents population in the United States, swallowing difficulty and inability to take oral medications were significant risk factors for pneumonia [42]. A recent study showed that more than 40% of patients hospitalized with an exacerbation of chronic obstructive airways disease have oropharyngeal swallowing disorders confirmed by a clinical swallow assessment [43]. Hospital admission with pneumonia should warrant increased clinical suspicion for dysphagia. Indeed, oropharyngeal dysphagia is present in 55% of older patients admitted for pneumonia and was related to higher mortality rates at 30 days and 1 year [1].

A post-mortem autopsy study in older patients from the Geriatric and Rehabilitation Department of the Geneva University Hospital showed that almost 43% of deaths were caused by pneumonia with a high proportion of AP [44].

Self-reported dysphagia significantly affects patient’s quality of life [4,45] and specific tools have been created to assess the dysphagia-specific quality of life. In respect to the consequences on the quality of life, the self-administrated “Deglutition Handicap Index”, offers both an evaluation of physical symptoms and an assessment of the functional and emotional consequences of dysphagia [46]. It is important to measure specific outcomes in oropharyngeal dysphagia, particularly the emotional, social and psychological consequences. To assess the severity of oropharyngeal

<table>
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<tr>
<th>Drug</th>
<th>Mechanism</th>
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<tr>
<td>Xerostomia</td>
<td>Antihypertensives, antihistamines H1, Parkinsonism drugs, anticholinergics, antipsasmodics, muscle relaxants, antipsychotics, tricyclic antidepressants, selective serotonin re-uptake inhibitors, antiemetics</td>
</tr>
<tr>
<td>Sedation</td>
<td>Bronchodilators, Opioids, Retinoids</td>
</tr>
<tr>
<td>Immunosuppression (adverse effects: gastrointestinal and esophageal)</td>
<td>Psychotropic agents, e.g. antianxiety agents, antidepressants, antipsychotic agents, sedative and hypnotic agents</td>
</tr>
<tr>
<td>Neuromuscular junction blockade</td>
<td>Anticonvulsants, Muscle relaxants, antipsasmodics</td>
</tr>
<tr>
<td>Myopathy</td>
<td>Antibiotics, Cytotoxic agents</td>
</tr>
<tr>
<td>Antibiotics (aminoglycosides, erythromycin)</td>
<td>Botulinum A toxin</td>
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<td>Penicillamine</td>
<td>Procanamide</td>
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<td>Corticosteroids</td>
<td>Lipid lowering agents</td>
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<td>L-Tryptophan</td>
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dysphagia, different tools already exist, like the SWAL-QOL [47–49] or more recently the Eating Assessment Tool (EAT-10), a self-administered test, that can be used to document the initial dysphagia severity and monitor treatment response [50].

6. Clinical features

Diagnosis may be quite simple if the patient presents with choking during or just after swallowing. Unfortunately, dysphagia’s symptoms are most frequently insidious and rarely mentioned by elder patients. Recognition of these symptoms and differentiating them from other age-related diseases can be difficult, particularly in patients with concomitant speech or cognitive difficulties.

As patients rarely mention spontaneously difficulties with swallowing [4,46], high suspicion index and a targeted interview of the patient and the caregiver on the patient’s mealtime behavior are important.

Clinical signs of dysphagia are not specific in geriatric patients. In a same patient, clinical presentation may fluctuate over time, and therefore needs to repeat observation and anamnesis with the patient and the caregivers. Observation of patients during mealtime and swallowing is a first step in the diagnostic approach of deglutition disorders. Several clinical signs should alert health professionals, for example prolonged duration of mealtime or prolonged chewing, persisting food remnants in the oral cavity, nasal reflux of food, slobbering during meal, feeling of blockage during swallowing and changes in voice quality, e.g. a wet voice just after swallowing. Other symptoms may be harder to associate with dysphagia: modifications of respiration or coughing at mealtime, reduction or refusal of food intake, changes in types of meal texture, recurrent pulmonary infections and unexplained bouts of fever or unintentional weight loss [51,52]. However, in a group of elder post-stroke patients, clinical features alone detected aspiration or penetration with a low sensitivity and specificity, 78% and 58% respectively [52,53].

7. Screening and diagnostic approaches

Early screening of dysphagia is important in order to identify patients who could benefit from a more complete assessment. Staff members who interact everyday with patients, particularly nurses or dietitians, specifically trained, are in the best position to perform this. Screening must be easy, time efficient, with low risk and costs, and must provide reliable results with good sensitivity.

It is important to evaluate the patient’s characteristics and especially cognitive status before deciding diagnostic investigations. Patients with cognitive impairment may fail to undergo some diagnostic examinations like video fluoroscopic swallowing examination if they don’t cooperate and are not able to understand simple orders during the examination. Clinical judgment is necessary for the geriatrician to identify those patients who will benefit from such investigations, considering the therapeutic objectives in each patient.

A recent review determined the effectiveness and practical feasibility of bedside screening methods in patients with neurological disorders [54].

Several studies on trial swallow methods using water, in various volumes between 5 ml and 60 ml, showed sensitivity and specificity ranges of 27% to 85%, and 50% to 88% respectively. Endpoints were defined as coughing, choking or wet voice [55–61]. Others used material with different viscosities to assess swallowing, like liquids, semi-solids or solids. Sensitivity ranged from 41% to 100% and specificity from 57% to 82% [52,54,60,61].

By measuring oxygen desaturation of more than 2% to evaluate aspiration and penetration, sensitivity between 56% and 87%, and specificity between 39% and 97% was obtained [56,57,60].

Finally, a swallow test in combination with oxygen desaturation showed the best values for sensitivity (73% to 98%) and specificity (63% to 76%) with the afore-mentioned endpoints (coughing, choking or wet voice) [57,58,60].

Several bedside screening tests currently exist, often initially developed for specific groups of patients, e.g. post-stroke or after head and neck surgery. They often lack validity in older populations [62,63]. The disparities in the bedside screening methods and protocols, as well as differences in the considered endpoints, makes it difficult to conclude on which is the optimal test to use.

Video fluoroscopic swallowing examination (VFSE) is often considered as the gold standard of study of the oral and pharyngeal phase of deglutition during a standard barium swallow [64]. This technique provides dynamic images of the bolus progression through the alimentary tract during the swallowing process, with information on safety (penetration or aspiration) and efficacy of deglutition. Also, it shows the influence of modifications in bolus consistency, posture and swallow maneuvers on bolus flow and clearance [37]. In neurological dysphagia, VFSE detects aspiration during the swallow phase, whereas flexible endoscopic evaluation of swallowing (FEES) is more effective in detecting aspiration in the post-swallow phase [65,66]. Radiation exposure limits frequent repetition of this test and patients must be alert, cooperating and able to understand and follow simple orders during the examination to perform the VFSE. Hence, patients with severe psychiatric or cognitive impairment often fail to undergo VFSE [51]. When aspiration is already confirmed and obvious or in case of acute pulmonary infection, this test should not be performed.

FEES has a comparable, if not superior, sensitivity to that of VFSE in the detection of aspiration [64]. It is usually safe and well tolerated. After transnasal passage of a flexible laryngoscope into the hypopharynx, FEES allows direct vision of the hypopharynx whereupon food and liquid can be presented and videotaped. It requires a skilled operator and specialized material but gives no information on the oral phase. In healthy elder volunteers, the number of penetrations and silent aspirations during FEES varies with the liquid type, the bolus volume and the delivery method [26].

Penetration and aspiration scores are perceived to be greater (more severe) when evaluated with FEES rather than with VFSE [66]. VFSE and FEES have been validated for oropharyngeal dysphagia diagnosis, but their respective strength and limitations are still a matter of debate [66].

Surface electromyography is a simple and reliable screening test for differentiating dysphagia and odynophagia of various origins. This radiation-free examination is non-invasive, time efficient, with low cost but fails to provide a precise diagnosis for neurological dysphagia [67].

Intraluminal manometry quantifies pharyngeal strength and upper esophageal sphincter (UES) relaxation during deglutition and evaluates the coordination between pharyngeal and esophageal structures. Manometry is useful when VFSE shows defects in the opening of the UES but neither identifies pharyngeal abnormalities, nor clarifies the etiology of dysphagia [51].

Considering the potential consequences of oropharyngeal dysphagia, more widespread dysphagia screening should be performed. Whether it should be based on clinical signs, patient and caregiver’s interview or bedside screening tests needs further investigation. Rofes et al. developed a clinical method based on a volume-viscosity swallow test using different volumes and bolus consistencies. A specific algorithm is used by the same team for screening, diagnosis and treatment of dysphagia [63].

In order to confirm dysphagia, evaluate its gravity and potential causes, and propose specific and early treatment options, we propose a screening and diagnostic algorithm that, though not yet
In general, an ideally vertical and symmetric position can facilitate a safe swallowing. Compensatory interventions are easy to perform and, by modifying oropharyngeal path dimensions, they facilitate and direct bolus flow. For example, in patients with stroke and hemiparesis, head rotation toward the paralyzed pharyngeal side during swallowing, head tilt to the stronger side before swallow or lying down are some examples of postures that can be used [37,63]. Anterior neck flexion by a simple chin tuck [45] reduces the speed of bolus passage when airway protection is delayed during transition between oral and pharyngeal phase of deglutition (Fig. 2). Swallow-facilitating maneuvers, e.g. supraglottic swallow, effortless swallow or the Mendelsohn maneuver, need sufficient comprehension capacities and cognitive abilities but also muscle strength to be performed. They modify single aspects of the swallowing process by improving safety and efficacy of swallowing [68].

Dietary modifications can be helpful in neurological dysphagia and decrease the risk of aspiration or penetration. Avoid thin liquids and restrict liquid intake to thickened or viscous liquids are simple and common interventions [13]. It is possible to reduce bolus volume or to change temperature or taste (sensory enhancement strategies) of food and liquids [69–71]. Alimentary thickening agents are an easy way to modify liquid textures but not necessarily result in greater safety for dysphagic patients, as is the case with Parkinson’s disease or dementia [72]. These compensatory strategies are not efficient in all cases but are non-invasive, cost efficient and easy to apply.

Functional training by active exercise programs is designed to improve tongue and respiratory muscle strength, but also movements of lips, jaws, larynx and vocal folds. This exercise-based rehabilitation seems to affect neural and behavioral plasticity [73,74]. Resistance exercise for the tongue and the oropharyngeal musculature is effective in older dysphagic patients [75,76].

When all the previous mentioned interventions have failed, considering an enteral or parenteral nutrition is an important and difficult decision in swallowing disorders. Exclusive enteral or parenteral nutrition may not eliminate any risk of aspiration pneumonia, since severely affected patients could still be exposed to an increased bacterial charge due to asymptomatic saliva penetration and aspiration. According to the latest recommendations of the European society of clinical nutrition and metabolism [40], tube feeding is indicated in patients with severe neurological dysphagia, but not in final disease state, including end stage dementia. Clinical judgment of the geriatrician, considering the patient’s wishes, comorbidities, prognostic, but also the potential

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**Fig. 1.** Screening algorithm of oropharyngeal dysphagia. Video fluoroscopic swallowing examination (VFSE); flexible endoscopic evaluation of swallowing (FEES).

**Fig. 2.** Examples of postural adjustments sometimes used as compensatory interventions in oropharyngeal dysphagia. From left to right: head rotation, head tilt and anterior neck flexion.
benefit of available therapeutic solutions is essential before banning oral alimentation or hydration.

9. Conclusion
Oropharyngeal dysphagia is a common and probably under diagnosed disorder in elderly patients, with potential life-threatening complications, such as malnutrition, dehydration and aspiration pneumonia. High index of suspicion for dysphagia symptoms is necessary, in order to improve diagnosis, identify the underlying etiologies and prevent complications. Specific therapeutic interventions should be proposed, taking into consideration the underlying pathology, the patient’s comorbidities and wishes.

Disclosure of interest
The authors declare that they have no conflicts of interest concerning this article.

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