

Oral Hygiene, Aspiration, and Aspiration Pneumonia: From Pathophysiology to Therapeutic Strategies

Omar Ortega Fernández · Pere Clavé

Published online: 5 October 2013
© Springer Science + Business Media New York 2013

Abstract Oropharyngeal dysphagia (OD) is a very prevalent condition in patients with neurological disorders and in the elderly, and has been shown to play a key role in the pathophysiology of aspiration pneumonia (AP), a frequent and severe complication in patients with OD. The pathophysiology of AP includes three main elements: (1) OD with impaired safety of swallow, aspirations, and frequently, impaired cough reflex; (2) poor oral health and oropharyngeal colonization by respiratory pathogens; and (3) frailty with malnutrition and poor immunity. Respiratory infections and AP lead to readmissions and high mortality among patients at risk, and appropriate management is important to avoid these complications. We have developed a therapeutic intervention including early screening, assessment, and treatment of patients at risk of OD. Those with OD are further assessed and treated for nutritional deficiency, oral hygiene, and oral diseases. This will reduce complications and morbidity and mortality among these patients.

Keywords Aspiration · Aspiration pneumonia · Oropharyngeal dysphagia · Oral health

Introduction

The oral cavity plays a key role in deglutition, being the point of entry for nutritional products. In addition, it contains a large, complex community of commensal and potentially pathogenic bacteria, particularly in cases of deficient oral hygiene. When mechanisms of swallowing are impaired and oral hygiene is poor, microorganisms living in the oral cavity can cause respiratory infections and aspiration pneumonia (AP). Oropharyngeal dysphagia (OD) is a swallowing dysfunction that affects many people, patients with neurological diseases and head and neck cancer, and especially, the elderly. It causes two groups of severe complications depending on the cause of the problem. If the patient presents impaired efficacy of swallow, he/she will suffer from malnutrition and dehydration; however, if the patient presents impaired safety of swallow and aspirations, he/she will develop respiratory infections and AP with increased morbidity and mortality [1]. AP occurs when colonized material from the oral cavity (liquids, food, and oral secretions) is aspirated into the lungs and pneumonia develops. The aim of this article is to review the most relevant recent literature to describe standards of practice in the treatment of patients with OD and the prevention of AP.

Oropharyngeal Dysphagia

The prevalence of OD is very high: studies have shown prevalences of 30–40 % in patients aged 65 years or older, up to 44 % in hospitalized patients in an acute geriatric unit (AGU), 60 % in institutionalized elders, more than 30 % in patients with cerebrovascular diseases, 52–82 % in patients with Parkinson disease, and 84 % in patients with Alzheimer

O. Ortega Fernández (✉) · P. Clavé
Unitat d'Exploracions Funcionals Digestives, Consorci Sanitari del Maresme, Hospital de Mataró, Universitat Autònoma de Barcelona, Carretera de Cirera s/n, 08304 Mataró (Barcelona), Spain
e-mail: oortega@csdm.cat

P. Clavé
Laboratori de Fisiologia Digestiva CIBERehd CSdM-UAB, CIBERehd, Instituto de Salud Carlos III, Barcelona, Spain
e-mail: pere.clave@ciberehd.org

disease [2, 3]. OD can be due to structural alterations (Zenker diverticulum, ear, nose, and throat tumors, osteophytes, and stenosis) or can be a side effect of head and neck cancer treatment (radiotherapy), but it is more commonly a functional disorder of the oropharyngeal swallow response caused by systemic or neurological diseases, stroke, or the aging process [4]. OD can impair both the efficacy and the safety of swallow.

The efficacy of swallow is the capacity to ingest all the necessary nutritional components to be well nourished. The main sign of impaired efficacy is oral residue, caused by alterations in bolus propulsion, and can lead to malnutrition and dehydration, causing frailty, sarcopenia, and impaired immunity and functionality [1, 4, 5]. The prevalence of malnutrition among elderly patients with OD is a serious problem and is very high, around 45.3 % in an AGU in patients over 70 years [6].

The safety of swallow is the capacity to swallow without penetrations or aspirations into the respiratory tract. The impairment of safety is caused by a delay in the protective reflexes in oropharyngeal reconfiguration caused by a slow neural swallow response. It is characterized by penetrations (the bolus penetrates the respiratory tract above the vocal chords) or aspirations (the bolus passes below the vocal folds), and the main complications are respiratory infections and AP [1, 5].

Aspiration Pneumonia

The pathophysiology of AP can be explained as the combination of risk factors that alter swallowing function, cause aspiration, and predispose the oropharynx to bacterial colonization [7, 8]. They include medication, altered conscience, neurodegenerative diseases, stroke, esophageal diseases, aging, malnutrition, antibiotics, dry mouth, impaired immune system, dehydration, and smoking [9]. We can classify them into three types of risk: (1) OD with impaired safety of swallow (aspirations); (2) frailty and impaired health status (malnutrition, sarcopenia, impaired immunity, comorbidities, and low functionality); and (3) poor oral health and poor oral hygiene with bacterial colonization by respiratory pathogens [10, 11]. Prevention of complications of OD and AP should be directed at all three risk groups. Our research group has been studying the oral health of elderly patients with OD: a first group ($n = 50$; 70 years or older) showed poor oral hygiene status [69 % had a simplified oral hygiene index score (OHI-S) of 3.1 or greater] and high prevalence of periodontal diseases and caries (93.3 % and 59.2 %, respectively) [12]. A second study found that these patients were more colonized by respiratory pathogens than people without OD (56 % colonization, load 0.43; $p < 0.05$ vs controls) [10].

One of the severest complications of OD is respiratory tract infections, including AP, with high associated mortality. We have recently performed several studies that demonstrated a strong relationship between OD and respiratory complications. In one study with 254 independently living elderly people (aged 70 years or older), the prevalence of OD assessed by the volume–viscosity swallowing test (V–VST) was 23 %, showing that OD is very prevalent in this group. They were followed up for 1 year, and subjects with OD had higher prevalence of lower respiratory tract infections (40 % vs 21.8 %; $p > 0.03$; odds ratio 2.39) and malnutrition (26 % vs 11.4 %; $p = 0.01$; odds ratio 2.72), showing that OD is a risk factor for malnutrition and lower respiratory tract infections [13, 14]. In two studies on elderly patients with community-acquired pneumonia (CAP) admitted to a general hospital, the prevalence of OD was assessed during hospitalization, and 55 % (patients aged 80 years or older) and 52.8 % (patients aged 70 years or older) presented OD. These patients with CAP were followed up for 1 year, and the mortality of patients with OD was higher (55.4 % vs 26.7 %, $p = 0.001$, in patients aged 80 years or older and 40 % vs 7 %, $p = 0.0157$, in patients aged 70 years or older). Both studies show that OD is a highly prevalent clinical finding in elderly patients with CAP and is an indicator of disease severity and bad prognosis [15, 16]. Another study showed OD increased hospital readmissions for pneumonia and AP. Up to 2,359 elderly patients (aged 70 years or older) from an AGU were screened for OD and followed up for 2 years. OD was present in 47.5 % of the patients, and these patients had more readmissions for pneumonia [6.7 readmissions per 100 patients with OD vs 3.6 readmissions per 100 patients with no OD, incidence rate ratio 1.82 (1.41–2.36)]; AP [2.3 readmissions per 100 patients with OD vs 0.45 readmissions per 100 patients with no OD, incidence rate ratio 1.37 (1.02–1.84)], and bronchoaspirations [4.8 readmissions per 100 patients with OD vs 1.1 readmissions per 100 patients with no OD, incidence rate ratio 4.36 (2.91–6.52)] [17]. Defining AP as pneumonia occurring in patients with swallowing disorders, the Japanese Study Group on Aspiration Pulmonary Disease reported that the proportion of admissions due to AP among all admissions due to pneumonia increases gradually with age, from 0 % in those aged 50 years or younger to as high as 90 % in those aged 90 years or older [18].

Therapeutic Strategies

To treat OD properly, it must first be screened and diagnosed. Nevertheless, many clinicians and health care providers do not systematically screen and assess patients at

risk of OD. It follows that OD is left out of medical reports, and complications such as AP are attributed to other etiological factors unrelated to OD [7, 8].

Currently, the main therapeutic strategies against OD are the adaptation of liquid and solid food by adjusting the volume and texture to reduce penetrations and aspirations [2], postural strategies and maneuvers to compensate biomechanical alterations, and nutritional supplements to avoid or improve malnutrition [19]. However, one of the most important aspects in the pathophysiology of AP, oral colonization, is not being properly screened for or treated with the implementation of oral hygiene. Our group has developed a project to establish a minimal massive intervention (the minimal effective intervention for the maximum number of patients) to avoid complications of OD among all elderly patients (70 years or older) admitted to our hospital. The intervention protocol is being introduced into the main hospital units treating elderly patients at risk of OD (geriatric and neurological units). This intervention consists of screening for OD using the V–VST [20] on admission and discharge, evaluating nutritional status using the MNA-SF [21] and assessing oral health and oral hygiene status with the OHI-S [22] and the presence of periodontal diseases and dental caries. The V–VST is a bedside clinical method which uses different volumes (5, 10, or 20 mL) and viscosities (nectar, liquid, and pudding) administered in a progression of increasing difficulty to protect the patient from aspirations. It combines the use of pulseoximetry to detect silent aspirations and is easy, cheap, and reliable (88.2 % sensitivity for impaired safety, 100 % sensitivity for aspirations, and 64.7 % specificity) [20]. If OD is diagnosed as severe, a second evaluation with videofluoroscopy, the gold standard, is performed using the same progression of boluses as were used in the V–VST, to assess swallowing alterations. Nutritional evaluation is performed by using the MNA-SF, which is a simple questionnaire validated for patients aged 65 years or older and which detects patients at risk of malnutrition or who are malnourished [21]; additionally, body mass index and bioimpedance are also good indicators of nutritional status. The OHI-S is used to determine the oral hygiene status; it is a simple test which evaluates the level of tooth covering of dental plaque (from 0 to 3) and calculus (from 0 to 3). It can be easily performed at the bedside, and the final result is obtained by adding both variables, which range from 0 to 6 (0 for perfect oral hygiene status and 6 for very poor oral hygiene status) [22]. Once the evaluations have been performed and registered in the medical reports, we provide recommendations to patients and their families on diet adaptations depending on the results of the V–VST and the nutritional evaluation, and good oral health practices to reduce bacterial colonization and avoid respiratory infections. Patients with OD

are followed up at four points, at 3, 6, 9, and 12 months, when we assess compliance with the treatment and reevaluate their status at that point. In addition, a registry of readmissions for respiratory infections and pneumonia is collected as are mortality rates. Several studies have demonstrated the importance of oral health care in the management of patients with OD at risk of AP [23], and recent reviews have concluded that mechanical oral hygiene has a preventive effect on mortality from pneumonia, and decreases the risk of nonfatal pneumonia in elderly patients [24, 25]. An estimated 10 % of deaths from pneumonia in elderly nursing home residents would be prevented by improving oral hygiene [24]. Furthermore, another recent study found that early screening and intensified oral hygiene reduced the incidence of X-ray-verified pneumonia compared with the control group without intervention (7 % vs 28 %; $p > 0.01$) [26•].

Conclusions

To conclude, we suggest three potential targets to reduce the risk of AP among the phenotype of frail elderly patients: (1) early screening and identification of patients with OD and subsequent treatment using clinical tools applicable in all hospitals and nursing homes; (2) nutritional assessment and treatment of malnutrition; and (3) routine assessment of oral health and appropriate treatment of periodontal diseases. Proper treatment of OD will reduce the incidence of AP, improve prognosis, and reduce the high morbidity and mortality rates.

Compliance with Ethics Guidelines

Conflict of Interest O. Ortega and P. Clavé declare they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

References

Papers of particular interest, published recently, have been highlighted as:

- Of importance
- Of major importance

1. Carrión S, Verin E, Clavé P, Laviano A. Complications of oropharyngeal dysphagia: malnutrition and aspiration pneumonia. In: Ekberg O, editor. *Dysphagia*. New York: Springer; 2012. p. 575–99.
2. Clavé P, Terre R, De Kraa M, Serra M. Approaching oropharyngeal dysphagia. *Rev Esp Enferm Dig*. 2004;96(2):119–26.

3. Ekberg O, Hamdy S, Woisard V, Wuttge-Hannig A, Ortega P. Social and psychological burden of dysphagia: its impact on diagnosis and treatment. *Dysphagia*. 2002;17(2):139–46.
4. Rofes L, Arreola V, Romea M, Palomera E, Almirall J, Cabre M, et al. Pathophysiology of oropharyngeal dysphagia in the frail elderly. *Neurogastroenterol Motil*. 2010;22(8):851–8.
5. Clave P, Verdaguer A, Arreola V. Oral-pharyngeal dysphagia in the elderly. *Med Clin*. 2005;124(19):742–8.
6. Carrión S, Cabré M, Montéis R, Roca M, Palomera E, Clavé P. Association between oropharyngeal dysphagia and malnutrition in elderly patients with acute diseases admitted to a general hospital. *Clin Nutr Suppl*. 2012;7(1):8.
7. Almirall J, Cabre M, Clave P. Aspiration pneumonia. *Med Clin*. 2007;129(11):424–32.
8. Marik PE, Kaplan D. Aspiration pneumonia and dysphagia in the elderly. *Chest*. 2003;124(1):328–36.
9. Almirall J, Cabre M, Clave P. Complications of oropharyngeal dysphagia: aspiration pneumonia. In: Cichero J, Clave P, editors. *Stepping stones to living well with dysphagia*. Basel: Karger; 2012. p. 67–76.
10. Ortega O, Sakwinska O, Mukherjee R, Combremont S, Jankovic I, Parra C, et al. High prevalence of colonization of oral cavity by respiratory pathogens in dysphagic patients. Twenty-first annual meeting of the Dysphagia Research Society; 2013. p. 89.
11. Tada A, Miura H. Prevention of aspiration pneumonia (AP) with oral care. *Arch Gerontol Geriatr*. 2012;55(1):16–21.
12. Parra C, Zarcero S, Nart J, Ortega O, Clavé P. Oral health in older patients with oropharyngeal dysphagia. *Dysphagia*. 2011;26:479.
13. Serra-Prat M, Hinojosa G, Lopez D, Juan M, Fabre E, Voss DS, et al. Prevalence of oropharyngeal dysphagia and impaired safety and efficacy of swallow in independently living older persons. *J Am Geriatr Soc*. 2011;59(1):186–7.
14. Serra-Prat M, Palomera M, Gomez C, Sar-Shalom D, Saiz A, Montoya JG, et al. Oropharyngeal dysphagia as a risk factor for malnutrition and lower respiratory tract infection in independently living older persons: a population-based prospective study. *Age Ageing*. 2012;41(3):376–81.
15. • Almirall J, Rofes L, Serra-Prat M, Icart R, Palomera E, Arreola V, et al. Oropharyngeal dysphagia is a risk factor for community-acquired pneumonia in the elderly. *Eur Respir J*. 2013;41(4):923–8. *“This study shows that OD is strongly associated with CAP and is an indicator of disease severity and bad prognosis. Consequently, older patients with CAP must be screened for OD.”*
16. Cabre M, Almirall J, Clave P. Aspiration pneumonia: management in Spain. *Eur Geriatr Med*. 2011;2(3):180–3.
17. •• Cabré M, Serra-Prat M, Force L, Almirall J, Palomera E, Clavé P. Oropharyngeal dysphagia is a risk factor for readmission for pneumonia in the very elderly: observational prospective study. *J Gerontol*. 2013. doi:10.1093/gerona/glt099. *This study shows that OD increases readmissions for pneumonia and AP and highlights the importance of proper treatment of and screening for OD to avoid complications.*
18. Teramoto S, Fukuchi Y, Sasaki H, Sato K, Sekizawa K, Matsuse T. High incidence of aspiration pneumonia in community- and hospital-acquired pneumonia in hospitalized patients: a multi-center, prospective study in Japan. *J Am Geriatr Soc*. 2008;56(3):577–9.
19. Sura L, Madhavan A, Carnaby G, Crary MA. Dysphagia in the elderly: management and nutritional considerations. *Clin Interv Aging*. 2012;7:287–97.
20. Clave P, Arreola V, Romea M, Medina L, Palomera E, Serra-Prat M. Accuracy of the volume-viscosity swallow test for clinical screening of oropharyngeal dysphagia and aspiration. *Clin Nutr*. 2008;27(6):806–15.
21. Kaiser MJ, Bauer JM, Ramsch C, Uter W, Guigoz Y, Cederholm T, et al. Validation of the mini nutritional assessment short-form (MNA®-SF): a practical tool for identification of nutritional status. *J Nutr Health Aging*. 2009;13(9):782–8.
22. Greene JC, Vermillion JR. Simplified oral hygiene index. *J Am Dent Assoc*. 1964;68(1):7–13.
23. Logemann JA, Curro FA, Pauloski B, Gensler G. Aging effects on oropharyngeal swallow and the role of dental care in oropharyngeal dysphagia. *Oral Dis*. 2013. doi:10.1111/odi.12104.
24. Sjogren P, Nilsson E, Forsell M, Johansson O, Hoogstraate J. A systematic review of the preventive effect of oral hygiene on pneumonia and respiratory tract infection in elderly people in hospitals and nursing homes: effect estimates and methodological quality of randomized controlled trials. *J Am Geriatr Soc*. 2008;56(11):2124–30.
25. van der Maarel-Wierink CD, Vanobbergen JN, Bronkhorst EM, Schols JMGA, de Baat C. Oral health care and aspiration pneumonia in frail older people: a systematic literature review. *Gerodontology*. 2013;30(1):3–9.
26. • Sorensen RT, Rasmussen RS, Overgaard K, Lerche A, Johansen AM, Lindhardt T. Dysphagia screening and intensified oral hygiene reduce pneumonia after stroke. *J Neurosci Nurs*. 2013;45(3):139–46. *This study shows the importance of a dysphagia screening and treatment program in reducing complications such as pneumonia prevalence.*