Sensitivity and specificity of V-VST in the clinical evaluation of subjects with COPD

Sensibilidade e especificidade do V-VST na avaliação clínica de sujeitos com DPOC

Sensibilidad y especificidad del V-VST en la evaluación clínica de sujetos con EPOC

Ana Paula Santos da Silva*
Bruna Franciele da Trindade Gonçalves*
Ivo Roberto Dorneles Prolla*
Renata Mancopes*

Abstract

Objective: to evaluate the sensitivity and specificity of the Volume-Viscosity Swallow Test (V-VST) protocol to detect the presence of dysphagia in patients with chronic obstructive pulmonary disease (COPD) in relation to the videofluoroscopy. **Method**: a cross-sectional, descriptive, analytical study with a convenience sample with individuals of both sexes, who entered in the Multiprofessional Program of Pulmonary Rehabilitation. Participants performed a speech-language clinical swallow evaluation using the V-VST protocol and an instrument performed by swallowing videofluoroscopy, and the results of these values calculated the sensitivity and specificity of the V-VST. **Results**: were evaluated 29 subjects with mean age of 63.9 ± 8.6 years (range 40-78 years), the majority of males (51.7%). Evaluation according to the V-VST protocol demonstrated that the majority of participants had swallowing without changes (55.2%). The V-VST analysis presented low sensitivity (39.10%) and low specificity (33.30%) in relation to videofluoroscopy with a positive predictive value of 69.20%. **Conclusion:** The application of the V-VST protocol for clinical evaluation of swallowing presented low sensitivity and specificity in relation to videofluoroscopy to identify the presence of dysphagia in subjects with COPD.

Keywords: Sensitivity; Specificity; Swallowing Disorders; Fluoroscopy; Chronic Pulmonary Obstructive Disease.

* Universidade Federal de Santa Maria, Santa Maria, RS, Brazil

Authors' contributions:
APSS, BFTG and IRDP contributed to the data collection, data analysis, and the drafting and proofreading of the paper
RM helped conceive the idea and contributed to the drafting and proofreading of the paper

Correspondence address: Ana Paula Santos Da Silva anapaulas.s@hotmail.com

Resumo

Objetivo: avaliar a sensibilidade e a especificidade do protocolo *Volume-Viscosity Swallow Test* (V-VST) para detectar a presença de disfagia em pacientes com doença pulmonar obstrutiva crônica (DPOC) em relação à videofluoroscopia. **Método**: estudo transversal, descritivo, analítico, com amostra de conveniência de indivíduos de ambos os sexos, ingressantes no Programa Multiprofissional de Reabilitação Pulmonar. Os participantes realizaram avaliação fonoaudiológica clínica da deglutição através do protocolo V-VST e avaliação instrumental pela videofluoroscopia da deglutição, sendo através dos resultados dessas calculado o valor de sensibilidade e especificidade do V-VST. **Resultados:** foram avaliados 29 sujeitos com média de idade de 63,9±8,6 anos (intervalo de 40 a 78 anos), a maioria do gênero masculino (51,7%). A avaliação segundo o protocolo V-VST demonstrou que a maioria dos participantes tinha deglutição sem alterações (55,2%). A análise do V-VST apresentou baixa sensibilidade (39,10%) e baixa especificidade (33,30%) em relação à videofluoroscopia com valor preditivo positivo de 69,20%. **Conclusão:** A aplicação do protocolo V-VST para avaliação clínica da deglutição apresentou baixa sensibilidade e especificidade em relação à videofluoroscopia para identificar a presença de disfagia em sujeitos com DPOC.

Palavras-chave: Sensibilidade; Especificidade; Transtornos de deglutição; Fluoroscopia; Doença pulmonar obstrutiva crônica.

Resumen

Objetivo: evaluar la sensibilidad y la especificidad del protocolo *Volume-Viscosity Swallow Test* (V-VST) para detectar la presencia de disfagia en pacientes con enfermedad pulmonar obstructiva crónica (EPOC) en relación a la videofluoroscopia. Método: estudio transversal, descriptivo, analítico con muestra de conveniencia de individuos de ambos sexos, ingresantes en el Programa Multiprofesional de Rehabilitación Pulmonar. Los participantes realizaron una evaluación fonoaudiológica clínica de la deglución a través del protocolo V-VST y evaluación instrumental por la videofluoroscopia de la deglución, siendo a través de los resultados de esas calculado el valor de sensibilidad y especificidad del V-VST. Resultados: fueron evaluados 29 sujetos con promedio de edad de 63,9 ± 8,6 años (intervalo de 40 a 78 años), la mayoría del género masculino (51,7%). La evaluación según el protocolo V-VST demostró que la mayoría de los participantes tenía deglución sin cambios (55,2%). El análisis del V-VST presentó baja sensibilidad (39,10%) y baja especificidad (33,30%) en relación a la videofluoroscopia con valor predictivo positivo del 69,20%. Conclusión: La aplicación del protocolo V-VST para evaluación clínica de la deglución presentó baja sensibilidad y especificidad en relación a la videofluoroscopia para identificar la presencia de disfagia en sujetos con EPOC.

Palabras clave: Sensibilidad; Especificidad; Trastornos de deglución; Fluoroscopia; Enfermedad pulmonar obstructiva crónica.

Introduction

Chronic obstructive pulmonary disease (COPD) is a lung disease that causes chronic obstruction of the air flow. Its causes include inhalation of particles or gases, smoking, and occupational dust[1].

In addition to pulmonary symptoms, the disease can affect the dynamics of other functions, such as swallowing[2]. Swallowing is a complex physiological process that safely transports saliva, foods, liquids or medicine from the oral cavity to the stomach, thus protecting the lower airways[3].

This extrapulmonary function has been further investigated, and studies indicate alterations in its biomechanics, that is, the occurrence of dysphagia in patients diagnosed with COPD[2,4,5].

Studies found alterations related to the reduction in the elevation of the hyolaryngeal complex, apnea alterations during swallowing, with inspiration-swallowing-expiration as its breathing pattern. That favors the penetration or aspiration of residue as well as silent aspiration, also associ-

ated with frequent exacerbations[5-8]. Thus, proper speech evaluation is necessary for early detection of dysphagia in order to minimize the damage and improve the subjects' quality of life[8].

The most commonly used methods to evaluate swallowing are clinical evaluation and instrumental tests such as videofluoroscopy, since the clinical evaluation alone does not accurately identify the occurrence of alterations in the biomechanics of swallowing in some cases[8].

The clinical evaluation is an inexpensive non-invasive method that contributes to having a safe oral intake, checking aspiration, water and nutritional risks, performing proper diagnosis and devising an adequate therapy process for each case, and also contributes to the prognosis of the patient[9].

The literature presents several protocols of clinical evaluation of swallowing, such as the *Volume-Viscosity Swallow Test* (V-VST). The V-VST is a quick and accurate validated tool that identifies dysphagia through the difficulties related to the safety and effectiveness of swallowing[10].

The sensitivity and specificity of the V-VST protocol were identified by applying it to subjects with difficulties in swallowing due to age, after a stroke or diagnosis of degenerative diseases[10,11]. However, we did not find studies investigating protocols of clinical evaluation of swallowing specifically for patients with COPD[8].

Videofluoroscopy is considered the gold standard for assessing swallowing among the methods of instrumental evaluation[9]. The use of barium contrast makes it possible to evaluate it dynamically and in real-time, assess various consistencies, verify food transit in the oral and pharyngeal stages of swallowing as well as various difficulties in the process[12]. In addition, it is possible to test the efficiency of the therapeutic, compensatory or postural mechanisms introduced, by evaluating it in regards to the different consistencies and volumes[13]. Also, the instrumental evaluation is the only way to identify silent aspirations.

Thus, this study aimed to evaluate the sensitivity and specificity of the V-VST Protocol in the detection of dysphagia in patients with COPD in comparison to videofluoroscopy.

Method

Design: Analytical descriptive cross-sectional study.

Sample and participants: The convenience sample was composed of individuals of both sexes, diagnosed with COPD according to an spirometry report in the previous six months, participating in an multidisciplinary program of lung rehabilitation (PMRP - Programa Multiprofissional de Reabilitação Pulmonar) in a university hospital, referred from the Pneumology Service or the Regional Coordination of Health from March 2016 to May 2017. The inclusion criteria were: not having had exacerbations in the previous six months, not being oxygen-dependent, not having sequels from a cerebrovascular accident, not having undergone head or neck surgery or radiation therapy, not having participated in programs of pulmonary rehabilitation, not having undergone speech therapy. The exclusion criteria were: diagnosis of both asthma and bronchiectasis, not being able to complete evaluations properly.

Instruments and data collection: The participants underwent a clinical speech evaluation of swallowing using the protocol *Volume Viscosity Swallow Test* (V-VST). The V-VST is an instrument validated in subjects with swallowing alterations related to age, after strokes and degenerative diseases[10,11]. It is easy to apply and its validation showed sensitivity and specificity for loss of feeding safety of 88.2% and 64.7%, respectively.

It aims to identify clinical signs of oropharyngeal dysphagia through difficulties related to the security in food intake without risks of aspiration. The parameters observed were cough, vocal alteration and decreased saturation.

Efficacy is understood as the adequate ability of sufficient water and calories intake for proper hydration and nutrition. The parameters observed were oral escape, oral residue, multiple swallows and pharyngeal residue[10,11,14].

The videofluoroscopy of swallowing was used for the analysis of sensitivity and specificity, as it is the gold standard instrumental evaluation. The videofluoroscopic evaluation was performed by a technician in radiology and a speech language therapist[13] experienced in this field in the radiology sector of the hospital, according to the usual protocol of videofluoroscopy proposed in the healthcare facility.

The patient was seated, and the following were observed in the oral phase: uptake of the alimentary bolus, lip closure, positioning of the bolus, extraoral escape, preparation/chewing, oral ejection, coor-

dination between the oral and pharyngeal phases and presence of residues in the oral cavity after swallowing. In the pharyngeal phase, the following aspects were observed: velopharyngeal closure, laryngeal penetration, tracheal aspiration, residue in pharyngeal recesses, valleculae, pharyngeal wall and piriform recesses, in addition to asymmetry in the downwards movement of the bolus through the pharynx. All of these aspects were observed with spoon volumes (10 ml) and free demand sips. Up to one swallowing per volume was considered normal, and more than one swallowing was considered multiple.

The consistencies used in the test were: Liquid: 15 ml liquid + 15 ml barium; Nectar: 30 ml liquid (pure barium); Honey: 15 ml liquid + 15 ml barium + 1 spoon of 3 ml of thickener; Pudding: 15 ml liquid + 15 ml barium + 1 1/2 spoon of 3ml of thickener; Solid: bread or cracker. The foods were prepared by the examiner a few minutes before the test and the contrast used was Bariogel®-Cristália/BR.

The videofluoroscopic images were obtained using a Siemens equipment, model Axiom *Iconos* R200. They were shot with the software ZScan6 Gastro – 6.1.2.11 edition, installed on an Itautec Infoway computer, Windows 7, with Intel Pentium P6200 processor. The images were recorded at 30 frames/second and the quality was ideal to study the regions viewed[15]. The anterior focus of the videofluoroscopic images was defined by the lips, the superior by the hard palate, the posterior by the posterior wall of the pharynx, and the inferior focus by the bifurcation of the airway and the esophagus, as high as the seventh cervical vertebra. The test

was carried out in the shortest period of time possible, so as to decrease the patient's exposure to radiation. In addition, the patient remained seated with his feet on the floor[13].

Ethical aspects: This research was approved by the Ethics Committee of the Universidade Federal de Santa Maria, under the number 1.967.549. The volunteers who agreed to participate in the research signed a Free and Informed Consent Form and the study followed the recommendations of the Resolution 466/12 of the National Health Council.

Statistical treatment: The data was filed in Excel spreadsheets and analyzed on the software Statistical Package for the Social Sciences, version 21.0 (SPSS Inc., Chicago, IL, USA). The continuous variables were presented as mean values and standard deviation, and the categorical variables as absolute and relative values. Sensitivity (Se), specificity (Sp), positive predictive value (PPV) and negative predictive value (NPV) were described in relative values.

Results

The study evaluated 29 subjects with an average age of 63.9±8.6 years (ranging from 40 to 78 years). Most of them were male (51.7%). The V-VST protocol evaluation showed that most participants did not present alterations in swallowing (55.2%).

Table 1 shows a comparison of the frequency distribution of the results of videofluoroscopy and V-VST.

ARTICLES

Table 1. Contingency table showing the distribution of frequency for videofluoroscopy and V-VST (N=29).

		Dysphagia according to videofluoroscopy (gold standard)	
		Present	**Absent**
Dysphagia according to V-VST (test)	Positive	9	4
	Negative	14	2

Table 2. Sensibility, specificity, predictive values of *Volume-Viscosity Swallow Test* (V-VST) for dysphagia

	Sensitivity	**Specificity**	**PPV**	**NPV**
V-VST	39.1%	33.3%	69.2%	12.5%

V-VST: Volume-Viscosity Swallow Test; PPV: Positive predictive value; NPV: Negative predictive value.

Table 2 shows the values of sensitivity, specificity, PPV, and NPV.

V-VST: Volume-Viscosity Swallow Test; PPV: Positive predictive value; NPV: Negative predictive value.

Discussion

COPD is a disabling disease that affects the subjects' quality of life and has a higher incidence in senior males[16].

This was also found in this study, in which 51.7% of subjects were male, aged 63.9±8.6 years (ranging from 40 to 78 years).

Several studies in the literature suggest alterations in the biomechanics of swallowing in subjects diagnosed with COPD[5-8].

Macri et al. (2013)[16] carried out a clinical evaluation of swallowing without any specific protocol and did not find oropharyngeal dysphagia. However, in the instrumental evaluation, there were alterations in the oral phase, especially premature posterior escape.

In another study, Bastilha et al. (2012)[7] also found alterations in the biomechanics of larger swallowing, specified by means of an instrumental study, as it allows a detailed view of food transit from the mouth to the stomach and is the only study that detects silent aspiration.

After the clinical evaluation of swallowing, the fluoroscopy analysis helps to see the possible changes in the dynamics of the oral and pharyngeal phases. It can evaluate the effectiveness of the swallowing process and of the treatment, thus, enabling the identification of factors that are difficult to observe clinically[17].

In this study, we could also verify that because the videofluoroscopy is considered the gold standard for instrumental examination, it better identified and characterized dysphagia in subjects with COPD (Table 1).

In a study in which Aguiar, Vale, Vicente (2018)[8] carried out a clinical evaluation of swallowing using the Mann Assessment of Swallowing Ability (MASA), dysphagia was found in 41.7% of the patients with COPD. The MASA is a validated test for the population that had a stroke, used to identify the presence of dysphagia and the risk of pulmonary aspiration. The authors used it because there are no validated tools for people diagnosed with COPD. In spite of that, they could identify dysphagia and risk of aspiration.

Similar results were found in this study using the V-VST protocol for the clinical evaluation of swallowing, as 44.8% of the sample was found to have dysphagia. However, we did not find specific protocols for the clinical evaluation of swallowing of subjects diagnosed with COPD.

This study aimed to evaluate the sensitivity and specificity of the V-VST protocol in order to identify alterations in the biomechanics of swallowing in the population with COPD, since subjects who had a stroke were evaluated and the results in identifying dysphagia were satisfactory.

The results described by Clavé et al. (2008)[14] identified the accuracy of the V-VST test for the clinical screening of the effectiveness and compromising of the safety of swallowing, and found

100% of sensitivity for aspiration, but a specificity of 28.8%.

Paris et al. (2012)[18] identified oropharyngeal dysphagia in patients with amyotrophic lateral sclerosis with a sensitivity of 93% and specificity of 80%. Among the 20 subjects participating in the study, 15 presented oropharyngeal dysphagia diagnosed by videofluoroscopy and 5 had normal swallowing. Among the 15 patients with oropharyngeal dysphagia, 14 had abnormal V-VST test results and only one had normal V-VST results.

Guillén-Solà et al. (2013)[19] evaluated the clinical screening capacity of V-VST for oropharyngeal dysphagia and aspiration in a homogeneous sample of individuals with a stroke and found that it is a highly sensitive and specific test to detect aspiration, with a sensitivity of 88.2% and specificity of 71.4%.

Rofes et al. (2014)[14] observed the sensitivity and specificity of the tool for food assessment and of the V-VST for clinical evaluation of oropharyngeal dysphagia and found that the V-VST test indicated a sensitivity of 94% and specificity of 88% for oropharyngeal dysphagia. That confirms that the clinical methods for oropharyngeal dysphagia evaluation offer excellent psychometric properties that enable an appropriate management of the senior population and the population of patients with a stroke.

In this study, the clinical evaluation of swallowing using the V-VST protocol was compared to the results of videofluoroscopy in order to verify the detection of dysphagia in subjects with COPD using only the protocol. The analysis showed low sensitivity (39.10%) and low specificity (33.30%), with a positive predictive value of 69.20% (Table 2). These findings suggest that the V-VST protocol alone cannot be used to diagnose the presence of dysphagia in COPD, because it is not possible to identify the actual alteration of the biomechanics of swallowing only by applying this protocol.

The results of this study corroborate the literature in regards to the need to combine the clinical and the instrumental examinations in the evaluation of swallowing whenever possible. These studies suggest that both methods are complementary and essential for the diagnosis and therapy planning for dysphagia, enabling a more accurate evaluation and more specific clinical behavior for each case[20].

It is suggested that similar studies are carried out with larger samples in order to scientifically contribute to the speech therapy clinical practice for patients with COPD.

Conclusion

The application of the V-VST protocol for clinical evaluation of swallowing showed low sensitivity and specificity in the identification of dysphagia in subjects with COPD, when compared to the videofluoroscopy. Such findings reinforce aspects evidenced by the clinical practice, that is, that existing protocols fail to completely identify dysphagia in this population. Thus, it is necessary to use the instrumental evaluation of swallowing whenever such resource is available.

References

1. GOLD: Global Strategy for the Diagnosis, Management and Prevention of COPD, Global Initiative for Chronic Obstructive Lung Disease. 2017. [cited 2017 Jul 27] Disponível em: http://goldcopd.org.

2. Chaves RD, Carvalho CRF, Cukier A, Stelmach R, Andrade CRF. Indicadores de disfagia na doença pulmonar obstrutiva crônica. In: Andrade CRF, Limongi SCO. Disfagia: prática baseada em evidências. São Paulo: Savier; 2012. p.151-66.

3. Fussi C, Arakawa-Sugueno L. Neurofisiologia da Deglutição. In: Barros APB, Dedivitis RA, Sant'ana RB. Deglutição, Voz e Fala nas Alterações Neurológicas. Rio de Janeiro: Di Livros; 2013. p.3-18.

4. Kobayashi S, Kubo H, Yanai M. Impairment of the swallowing reflex in exacerbations of COPD. Thorax. 2007; 62(11): 1017.

5. Gross RD, Atwood CW, Ross SB, Olszewski JW, Eichhorn KA. The coordination of breathing and swallowing in chronic obstructive pulmonary disease. Am J Respir Crit Care Med. 2009; 179(7): 559–65.

6. Cvejic L, Harding R, Churchward T, Turton A, Finlay P, Massey D, Bardin PG, Guy P. Laryngeal penetration and aspiration in individuals with stable COPD. Respirology. 2011; 16: 269-75.

7. Bastilha GR, Mancopes R, Gonçalves BFT, Bilheri, DFD. Resultados da avaliação clínica e objetiva da deglutição em paciente com tosse crônica: relato de caso. Int. Arch. Otorhinolaryngol. 2012: 16(Suppl. 1): 98.

8. Aguiar FCF, Vale SL, Vicente LCC. Doença pulmonar obstrutiva crônica: análise da deglutição em pacientes hospitalizados. Distúrb Comum. 2018; 30(1): 147-57.

9. Vale-Prodomo LP, Carrara-De Angelis E, Barros APB. Avaliação clínica fonoaudiológica das disfagias. In: Jotz GP, Carrara-De Angelis E, Barros APB. Tratado de deglutição e disfagia: no adulto e na criança. Rio de Janeiro: Revinter; 2010. p.61-7.

10. Rofes L, Arreola V, Clavé P. The volume-viscosity swallow test for clinical screening of dysphagia and aspiration.Nestle Nutr Inst Workshop Ser. 2012; 72: 33-42.

ARTICLES

11. Rofes L, Arreola V, Mukherjee R, CLAVÉ P. Sensitivity and specificity of the Eating Assessment Tool and the Volume-Viscosity Swallow Test for clinical evaluation of oropharyngeal dysphagia. Neurogastroenterol Motil. 2014; 26(9): 1256–65.

12. Dozier TS, Brodsky MB, Michel Y, Walters BC, Martin-Harris B. Coordination of swallowing and respiration in normal sequential cup swallows. Laryngoscope. 2006; 116(8): 1489-93.

13. Barros APB, Silva SAC, de Angelis EC. Videofluoroscopia da deglutição orofaríngea. In: Jotz GP, de Angelis EC, Barros APB. Tratado de deglutição e disfagia: no adulto e na criança. Rio de Janeiro: Revinter. 2010; cap. 11. p. 84-8.

14. Clavé P, Arreola V, Romea M, Medina L, Palomera E, Serra-Prate M. Accuracy of the volume-viscosity swallow test for clinical screening of oropharyngeal dysphagia and aspiration. Clin Nutr, [S.l.]. 2008; 27(6): 806-15.

15. Costa MMB. Videofluoroscopia: método radiológico indispensável para a prática médica. Radiol Bras. 2010; 43(2): 7-8.

16. Macri MRB, Marques JM, Santos RS, Furkim AM, Melek I, Rispoli D, et al. Clinical and fiberoptic endoscopic assessment of swallowing in patients with chronic obstructive pulmonary disease. Int. Arch. Otorhinolaryngol. 2013; 17(3): 274-8.

17. Silva AEF. Modelação de um Software para Análise Qualitativa e Quantitativa da Deglutição Orofaríngea por Videofluoroscopia. [Dissertação]. Portugal: Faculdade de Medicina da Universidade do Porto; 2016.

18. Paris G, Martinaud O, Hannequin D, Petit A, Cuvelier A, Guedon E, Ropenneck P, Verin E. Clinical screening of oropharyngeal dysphagia in patientes with ALS. Ann Phys Rehabil Med. 2012; 55(9-10): 601-8.

19. Guillén-Solà A, Marco E, Martínez-Orfila J, Mejìas FD, Passalacqua MD, Duartea E, Escalada F. Usefulness of the volume-viscosity swallow test for screening dysphagia in subacute stroke patients in rehabilitation income. Neuro Rehabilitation. 2013; 33: 631–8.

20. Sordi M, Mourão LF, Silva AA, Flosi LCL. Importância da interdisciplinaridade na avaliação das disfagias: avaliação clínica e videofluoroscópica da deglutição. BRAZ J Otorhinolaryngology. 2009; 76(6): 776-87.