

# The association between saliva control, silent saliva penetration, aspiration, and videofluoroscopic findings in Parkinson's disease patients

Ali Rajaei<sup>1</sup>, Fereshteh Ashtari<sup>1,2</sup>, Seyed Abolfazl Azargoon<sup>3</sup>, Ahmad Chitsaz<sup>1,2</sup>, Mohammad Hussein Nilforoush<sup>4</sup>, Masoud Taheri<sup>5</sup>, Saba Sadeghi<sup>3</sup>

<sup>1</sup>Isfahan Neurosciences Research Center, Alzahra Hospital, <sup>2</sup>Department of Neurology, Isfahan University of Medical Sciences, <sup>3</sup>Mahoor Clinic of Speech and Language Pathology, <sup>4</sup>Department of Audiology, School of Rehabilitation Sciences, Isfahan University of Medical Sciences, <sup>5</sup>Department of Radiology, Isfahan Health Management of Social Security Organization, Isfahan, Iran

## Abstract

**Background:** Dysphagia is a common disorder among patients with Parkinson's disease (PD). It occurs in up to 80% of all (PD) patients during the early stages of the disease and up to 95% in the advanced stages; but professionals may not hear from the patients about dysphagia symptoms until these symptoms reach an advanced stage and lead to medical complications.

**Materials and Methods:** Thirty-three PD patients (mean age  $66.09 \pm 9.4$  years; 24 men, nine women) participated in this study at our Neurology Institute, between April 20, 2013, and October 26, 2013. They were asked two questions; one about saliva control and the other about silent saliva penetration and aspiration. Next, they underwent the videofluoroscopic swallowing study (VFSS).

**Results:** The Pearson Correlation coefficient between the Penetration–Aspiration Scale (PAS) scores and question 1 scores was 0.48 ( $P < 0.05$ ,  $\rho = 0.25$ ), and there was a significant correlation between the PAS scores and question 2 scores, and also question 1 scores + question 2 scores ( $r = 0.589$ ,  $P < 0.05$ ,  $\rho = 0$  and  $r = 0.589$ ,  $P < 0.05$ ,  $\rho = 0$ ).

**Conclusions:** This study showed a significant correlation between the questions about saliva control, silent saliva penetration, and aspiration, and laryngeal penetration and aspiration during VFSS. Therefore, by using these two questions, the potential silent laryngeal penetration and aspiration during meals could be detected before it led to aspiration pneumonia. Taking the benefit of these questions, as a part of the swallowing assessment of PD patients, is recommended.

**Key Words:** Dysphagia, Parkinson's disease, saliva control, silent saliva penetration and aspiration, videofluoroscopic swallow study

## Address for correspondence:

Prof. Fereshteh Ashtari, Kashani Hospital, Isfahan, Iran. E-mail: [f\\_ashtari@med.mui.ac.ir](mailto:f_ashtari@med.mui.ac.ir)

Received: 08.02.2014, Accepted: 01.09.2014

Access this article online	
Quick Response Code:	Website: <a href="http://www.advbiores.net">www.advbiores.net</a>
	DOI: 10.4103/2277-9175.157815

## INTRODUCTION

Parkinson's disease (PD) is considered to be associated with progressive degeneration of the cortical and subcortical neurons, mid-brain, and brainstem.<sup>[1]</sup> Different non-motor and motor symptoms can be present in PD patients<sup>[2]</sup> and dysphagia occurs in up to 80% of all patients during the early stages of the disease and up

Copyright: © 2015 Rajaei. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

**How to cite this article:** Rajaei A, Ashtari F, Azargoon SA, Chitsaz A, Nilforoush MH, Taheri M, *et al.* The association between saliva control, silent saliva penetration, aspiration, and videofluoroscopic findings in Parkinson's disease patients. *Adv Biomed Res* 2015;4:108.

to 95% in the advanced stages.<sup>[3,4]</sup> The quality-of-life in patients with PD is significantly affected by dysphagia<sup>[5]</sup> and the risk of aspiration pneumonia, reported to be the leading cause of death in Parkinson's disease,<sup>[6]</sup> increases due to oropharyngeal dysphagia.<sup>[7,8]</sup> However, PD patients may report swallowing disturbances to physicians just as these disturbances reach an advanced stage, which can lead to medical problems. Underrecognition and inadequate awareness of the presence of dysphagia and its symptoms among the health professionals, caregivers, and patients, as also the activation of efficient swallowing compensatory mechanisms, may be among the possible explanations.<sup>[9]</sup> Thus, we have set two relevant questions that give the professionals (dysphagia team members) valuable and useful information about oral and pharyngeal phases of swallowing in this population. The questions are about frequent dysphagia symptoms among PD patients. One of them triggers saliva control and the other is about silent saliva penetration/aspiration. As is clinically observed, we hypothesize that saliva control and silent saliva penetration/aspiration are associated with laryngeal penetration and aspiration during videofluoroscopic swallow study (VFSS) and also during meals. The aim of this study is to determine the association between the answers given by the patients to questions 1 and 2 and the findings of videofluoroscopic swallowing—the gold standard for evaluating oral and pharyngeal mechanisms of swallowing disturbances and also the anatomical structures involved in the oropharyngeal phases of swallowing.<sup>[10,11]</sup>

## MATERIALS AND METHODS

Thirty-three consecutive patients with clinically definite PD<sup>[12]</sup> (mean age, 66.09 ± 9.4 years; 24 men, nine women), who were referred to our Neurology Institute for their routine medical care, between April 20, 2013 and October 26, 2013, met the inclusion and exclusion criteria and participated in our study. The inclusion criteria were: (1) The ability to understand spoken Farsi and (2) the ability to tolerate a sitting position. The exclusion criteria included: (1) A history of other neurodegenerative disorders, stroke, encephalitis, head injuries, dementia, severe depression, and so on; (2) a history of other diseases that cause dysphagia; (3) being fed by a tube; and (4) a history of respiratory infections. The study was approved by the Ethical Committee of our institute and a written informed consent was signed by all the patients before the start of this study. After descriptive data collection (age, gender, disease duration) and the Hoehn and Yahr staging scale (H and Y) determination by a neurologist [Table 1], all the patients, effectively treated with L-dopa, were asked to answer two questions: (1) “How many times do

**Table 1: Descriptive data collection**

Total number of patients	33			
Gender	Twenty-four male		Nine female	
Age mean: (50–83) years	66.09	70.55	64.41	
Disease duration	Up to one year: Seven patients	Between one and five years: 19 patients	More than five years: Seven patients	
H and Y staging scale mean: 2.06	H and Y=1 Eight patients	H and Y=2 18 patients	H and Y=3 Four patients	H and Y=4 Three patients

you drool or have uncontrolled saliva?” and (2) “How many times does the saliva have you coughing or experiencing breathing problems?” The rating system was: 0 points for never, 1 point for rarely (once a week or less), 2 points for frequently (one to seven times a week), and 3 points for very frequently (more than seven times a week). Afterward, they underwent VFSS. The videofluoroscopic swallow study was performed from the side during the patients ‘On’ state.i.e. after medicine taken and four bolus types were administered: Five milliliters of thin liquid with a spoon, thin liquid with a cup (self-administered), a spoon with 5 ml of semisolid, and half a cookie.<sup>[13]</sup> The patients’ videos were recorded on individual compact disks for further analysis. The videos were evaluated by an assessor (blind to the question scores and patients’ health condition), with regard to laryngeal penetration and aspiration (as the most significant signs during VFSS) by using the Penetration–Aspiration Scale (PAS) [Table 2].<sup>[14]</sup> Then another assessor evaluated 22 VFSS videos and these videos were also re-evaluated by the first assessor in order to confirm the reliability of the VFSS result evaluation.

We compared the scores of questions 1 and 2 individually and the scores of question 1 + question 2 with the PAS scores, using the Pearson correlation test.  $\kappa$  Coefficient was used to determine the inter-rater and intra-rater reliability of the VFSS result evaluations.

## RESULTS

On the basis of the VFSS results, 15 patients (45.45%) had laryngeal penetration and aspiration (three aspirations [Table 3]. Eighteen patients (54.54%) claimed that they had never experienced symptoms indicated in questions 1 and 2 [Table 4]. There were no significant differences between the patients with laryngeal penetration and aspiration during VFSS and patients without these findings, in terms of sex, age, disease duration, and H and Y stage. Also no significant differences were seen between the patients who had never experienced the symptoms indicated in questions

1 and 2 and the other patients, with regard to the above terms. Evaluation of the VFSS results was highly consistent — internal consistency ( $\kappa$  Coefficient 1.00) and consistency between the assessors ( $\kappa$  coefficient 0.90, 95% confidence interval (CI)). The Pearson correlation coefficient between the PAS scores and question 1 scores was 0.48 ( $\rho < 0.05$ , =0.25), and there was a significant correlation between the PAS scores and question 2 scores, and also question 1 scores + question 2 scores ( $r = 0.589$ ,  $\rho < 0.05$ , =0 and  $r = 0.589$ ,  $\rho < 0.05$ , =0) [Table 5].

## DISCUSSION

Our findings demonstrated a strong correlation between the PAS scores of the PD patients and the scores of the questions on saliva control (question 1) and silent saliva penetration/aspiration (question 2), as also on the score of question 1 + question 2 [Table 5]. Therefore, the potential silent laryngeal penetration and aspiration during meals may be detected by using these two questions, and consequently, the risk of complications such as aspiration pneumonia may decrease. PD patients may report swallowing disturbances just as these disturbances reach an advanced stage and lead to medical problems. Underrecognition and inadequate awareness of the presence of dysphagia and its symptoms, as also the activation of efficient swallowing compensatory mechanisms, among the health professionals, caregivers, and patients, may be among the possible explanations.<sup>[9]</sup> The presence of the cognitive dysexecutive syndrome among most PD patients may be another explanation.<sup>[15,16]</sup> It is also mentioned that relying solely on self-reporting swallowing disturbances can affect the detection of the existing problems.<sup>[9]</sup> Thus, it seems necessary that health professionals, generally speech and language pathologists, benefit from precise, localized, and *ad hoc* questions, which can trigger different symptoms of dysphagia in PD patients and encourage these patients to describe these problems by their expressions during the procedure of history-taking, assessment, and treatment of dysphagia. Creating more detailed and localized questions and questionnaires, similar to the Swallowing Disturbance Questionnaire (SDQ), a valid tool for detecting swallowing problems among PD patients,<sup>[9]</sup> and measuring their validity and reliability in other languages is suggested. Considering the disadvantages of instrumental evaluations like VFSS (exposure to x-rays, financial costs, etc.), the need for sufficient trained professionals for performing these types of evaluations and also lack of adequate professionals in the third-world and developing countries may be reason enough for the importance of paying more attention to creating valid and reliable questionnaires and benefiting from detailed, localized,

**Table 2: Penetration-aspiration scale**

Category	Score	Descriptions
No penetration or aspiration	1	Contrast does not enter the airway
Penetration	2	Contrast enters the airway, remains above vocal folds; no residue
	3	Contrast remains above the vocal folds; visible residue remains
	4	Contrast contacts vocal folds; no residue
	5	Contrast contacts vocal folds; visible residue remains
Aspiration	6	Contrast passes glottis; no subglottic residue visible
	7	Contrast passes glottis; visible subglottic residue despite patient's response
	8	Contrast passes glottis; visible subglottic residue; absent patient response

**Table 3: Patients PAS scores**

PAS scores	1	2	3	4	5	6	7	8
Number of patients (total=33)	18	8	3	0	1	0	0	3

PAS: Penetration-aspiration scale

**Table 4: Scores of question 1, question 2, and question 1+question 2**

Scores	0	1	2	3	4	5	6
Q1	20	3	4	6			
Q2	25	3	3	2			
Q sum	18	5	2	2	2	3	1

**Table 5: Pearson correlation test**

Nothing	Pearson correlation value	$\rho$ -value
Q1	0.48	0.025
Q2	0.589	0
Q sum	0.589	0

and easy-to-use questions for dysphagia in this population.

On the basis of our results, there were no significant differences between mean the H and Y stage of patients with and without laryngeal penetration and aspiration during VFSS. Previously, it was shown that H and Y staging did not always correlate with the dysphagia status.<sup>[17]</sup> Thus, early diagnosis and early intervention (during the first stages) should be considered in order to reduce the risk of other complications.

To conclude, this study shows a significant correlation between questions about saliva control, silent saliva penetration and aspiration, and laryngeal penetration and aspiration during VFSS. Therefore; by using these two questions potential silent laryngeal penetration and aspiration during meals may be detected before it leads to aspiration pneumonia. We recommend using

these questions as a part of swallowing assessment of PD patients, and in the future we intend to create more useful questions and also translate and measure the validity and reliability of *ad hoc* questionnaires like SDQ.

## ACKNOWLEDGMENT

The authors are very grateful to the patients for participating in this study.

## REFERENCES

1. Braak H, Rüb U, Gai WP, Del Tredici K. Idiopathic Parkinson's disease: Possible routes by which vulnerable neuronal types may be subject to neuroinvasion by an unknown pathogen. *J Neural Transm* 2003;110:517-36.
2. Samii A, Nutt JG, Ransom BR. Parkinson's disease. *Lancet* 2004;363:1783-93.
3. Nagaya M, Kachi T, Yamada T, Igata A. Videofluorographic study of swallowing in Parkinson's disease. *Dysphagia* 1998;13:95-100.
4. Wintzen AR, Bradrising UA, Roos RA, Vielvoye J, Liauw L, Pauwels EK. Dysphagia in ambulant patients with Parkinson's disease: Common, not dangerous. *Can J Neurol Sci* 1994;21:53-6.
5. Plowman-Prine EK, Sapienza CM, Okun MS, Pollock SL, Jacobson C, Wu SS, *et al.* The relationship between quality of life and swallowing in Parkinson's disease. *Mov Disord* 2009;24:1352-8.
6. Troche MS, Sapienza CM, Rosenbek JC. Effects of bolus consistency on timing and safety of swallow in patients with Parkinson's disease. *Dysphagia* 2008;23:26-32.
7. Beyer MK, Herlofson K, Arslan D, Larsen JP. Causes of death in a community-based study of Parkinson's disease. *Acta Neurol Scand* 2001;103:7-11.
8. Mehanna R, Jankovic J. Respiratory problems in neurologic movement disorders. *Parkinsonism Relat Disord* 2010;16:628-38.
9. Monte FS, da Silva-Júnior FP, Braga-Neto P, Nobre e Souza MA, de Bruin VM. Swallowing abnormalities and dyskinesia in Parkinson's disease. *Mov Disord* 2005;20:457-62.
10. Clavé P, Terré R, de Karaa M, Serra M. Approaching oropharyngeal dysphagia. *Rev Esp Enferm Dig* 2004;96:119-31.
11. Cook IJ, Kahrilas PJ. AGA technical review on management of oropharyngeal dysphagia. *Gastroenterology* 1999;116:455-78.
12. Calne DB, Snow BJ, Lee C. Criteria for diagnosing Parkinson's disease. *Ann Neurol* 1992;32(Suppl):S125-7.
13. Malandraki GA, Hind JA, Gangnon R, Logemann JA, Robbins J. The utility of pitch elevation in the evaluation of oropharyngeal dysphagia: Preliminary findings. *Am J Speech Lang Pathol* 2011;20:262-8.
14. Rosenbek JC, Robbins JA, Roecker EB, Coyle JL, Wood JL. A penetration-aspiration scale. *Dysphagia* 1996;11:93-8.
15. Bondi MW, Kaszniak AW, Rapcsak SZ, Butters MA. Implicit and explicit memory following anterior communicating artery aneurysm rupture. *Brain Cogn* 1993;22:213-29.
16. Stocchi F, Brusa L. Cognition and emotion in different stages and subtypes of Parkinson's disease. *J Neurol* 2000;247(Suppl 2):II114-21.
17. Ali GN, Wallace KL, Schwartz R, DeCarle DJ, Zagami AS, Cook IJ. Mechanisms of oral-pharyngeal dysphagia in patients with Parkinson's disease. *Gastroenterology* 1996;110:383-92.

**Source of Support:** Nil, **Conflict of Interest:** None declared.