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Correlation between oral and pharyngeal transit time in stroke

Correlação entre tempo de trânsito oral e faríngeo no acidente vascular cerebral

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ABSTRACT

Purpose: To correlate the total oral transit time (TOTT) with initiation of pharyngeal response (IPR) and pharyngeal transit time (PTT) in stroke. **Methods:** The study included 61 swallowing videofluoroscopy exams of individuals after hemispheric ischemic stroke. Of these, 28 were male and 33 female, with ages ranging from 40 to 101 years (mean 65 years). For analysis of the results, individuals were divided into two groups. Group 1 (G1) consisted of 17 individuals with TOTT up to 2000 ms, as normality, and Group 2 (G2) consisted of 44 individuals with TOTT greater than 2000 ms. Temporal measurement of oropharyngeal swallowing was performed. Each individual was observed during the swallowing of a 5 mL spoonful of food in puree consistency. The Spearman´s rank correlation coefficient test was applied. **Results:** There was no correlation between G1 and IPR and PTT. There was weak correlation between G2 and the studied parameters. **Conclusion:** The increase of TOTT in the stroke individual has weak correlation with increased time in the pharyngeal phase.

Keywords: Stroke; Deglutition disorders; Evaluation; Quantitative analysis; Software

RESUMO

Objetivo: Correlacionar o tempo de trânsito oral total (TTOT) com o início da resposta faríngea (IRF) e o tempo de trânsito faríngeo (TTF) no indivíduo, após acidente vascular cerebral (AVC). **Métodos:** O estudo incluiu 61 exames de videofluoroscopia de deglutição de indivíduos após AVC hemisférico isquêmico. Destes, 28 eram do gênero masculino e 33 do gênero feminino, com faixa etária variando de 40 a 101 anos (média de 65 anos). Para análise dos resultados, os indivíduos foram divididos em dois grupos. O Grupo 1 (G1) constou de 17 indivíduos com tempo de trânsito oral total até 2000 ms, conforme normalidade, e o Grupo 2 (G2), de 44 indivíduos com tempo de trânsito oral total maior que 2000 ms. Foi realizada análise quantitativa da deglutição orofaríngea. Cada indivíduo foi observado durante a deglutição de uma colher de 5 ml com alimento na consistência pastosa. Foi aplicado o teste de correlação de Spearman. **Resultados:** Não houve correlação entre o G1 e a IRF e o TTF. Houve fraca correlação entre o G2 e os parâmetros estudados. **Conclusão:** O aumento do tempo de trânsito oral total no indivíduo após AVC possui correlação fraca com o aumento do tempo na fase faríngea.

Descritores: Acidente vascular cerebral; Transtornos de deglutição; Avaliação; Análise quantitativa; Software

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INTRODUCTION

A quantitative investigation of transit times from oral and pharyngeal phases have been used in the current study with stroke and dysphagic individuals. The change in these times, specifically in stroke, can compromise the degree of swallowing difficulty, contributing to maximizing nutritional losses and pulmonary safety of the dysphagic individual[1-9].

The measurement of these times related to swallowing events is an important measure for the clinician in the assessment of swallowing, assisting in the identification of findings that can predict laryngotracheal aspiration and also aid in defining the course of treatment[10].

One study consisting of a qualitative analysis, through videofluoroscopy, of the oral and pharyngeal phase of swallowing with stroke individuals, showed that the delay in the initiation of pharyngeal phase, slow oral transit and laryngeal penetration are strong risk factors for subsequent complications of dysphagia in this population[11].

Another study, a quantitative analysis of the oral and pharyngeal phase including the use of foods with and without flavor, showed reduced oral time in stroke individuals when associated with flavor and temperature[9].

Other studies with qualitative analysis by swallowing videofluoroscopy observed an increase in oral transit time[12] and delayed initiation of pharyngeal response[13] in stroke individuals when compared to healthy individuals, particularly in solid and puree consistencies[14].

Other studies also showed that stroke individuals with increase pharyngeal transit time, duration of laryngeal closing and pharyngeal response time should alert the clinician to possible changes to other parameters such as a reduction in laryngeal elevation, pharyngeal and vallecular residue and decreased protection of the lower airways[15,16]. Together, these are considered the best predictors of risk for aspiration[10].

The literature is not concise about the exact markings for the initiation and end of each phase of swallowing, as the values of each oropharyngeal transit time are variable according to the methodology applied by authors[17-19].

Therefore, this study aimed to verify whether there is correlation between oral transit time to the initiation of pharyngeal response and pharyngeal transit time in the stroke individual.

METHODS

This was a prospective cross-sectional clinical study. The neurological diagnosis of stroke and cortical involvement was carried out through neurological clinical assessment and confirmed by neuroimaging exams such as computed tomography (CT) and/or magnetic resonance imaging (MRI). The mean time between the date of stroke and the individual's inclusion in the study was ten days (standard deviation=10.99), ranging from 0 to 30 days.

We analyzed 61 videofluoroscopic swallowing studies from the Dysphagia Research Center database of *Universidade Estadual Paulista* "Júlio de Mesquita Filho" (UNESP) of individuals after hemispheric ischemic stroke, with injury to either the right or left side, together with mild to severe oropharyngeal dysphagia who had not undergone cerebral reperfusion. Of these, 28 were male and 33 female, with ages ranging from 40 to 101 years (mean 65 years, standard deviation=13.57) (Appendix 1). For analysis, the individuals were divided into two groups. Group 1 (G1) consisted of 17 individuals with oral transit time up to 2000 ms, conforming to normality, with a mean age of 62 years and standard deviation of 11.41 years. Group 2 (G2) included 44 individuals with oral transit time greater than 2000 ms, with a mean of 66 years and standard deviation of 14.36 years[19].

The study protocol was approved by the Ethics Committee of the UNESP, under number 0553/2012. All individuals, or their legal representatives, included in the study protocol were informed and signed a form of free and informed consent.

It were excluded from the study individuals with hemorrhagic stroke and with previous history of stroke.

Swallowing videofluoroscopy, including both service and data collection, was performed in two reference centers specializing in dysphagia patient care. Only the swallowing of 5 mL volume of puree consistency (safest consistency for these individuals) of the first spoon offered was considered for analysis[20].

To perform swallowing videofluoroscopy, a puree consistency was prepared with a measure of food thickener (4 g) comprising of a mixture of carbohydrates and minerals containing 360 Kcal/100g. The thickener was added to 40 ml of water and 15 ml of barium sulfate (BaSO4). A disposable syringe was used for measuring both the volume of water and barium.

Subsequently, the exams were digitalized so they could be quantitatively analyzed by means of specific software[21]. Frame-by-frame analysis was performed in which the bolus initiation and end to the oral and pharyngeal phase was marked, thus obtaining the time of each stage by the counting of frames.

We analyzed three oropharyngeal swallowing time parameters: total oral transit time (TOTT), initiation of pharyngeal response (IPR) and pharyngeal transit time (PTT).

Beginning of TOTT was considered when food was in the oral cavity and end when the proximal portion of the bolus was in the end region of the hard palate and the beginning of the soft palate, making angle with the ramus and tongue base[22].

IPR time was defined as the interval in ms from the time the bolus was in the end region of the hard palate and beginning of the soft palate, making angle with the ramus and tongue base, until the first video frame indicating elevation movement of the larynx[10,22].

The initiation of PTT was considered when the part of the

bolus was in the end region of the hard palate and beginning of the soft palate making angle with the ramus and tongue base, and as the end of the pharyngeal phase of swallowing, the moment when the bolus passed through the upper esophageal sphincter[6,23].

In this study, quantitative analysis of swallowing exams through software was performed by two speech-language pathologist judges[24] with experience in instrumental examination and trained by the same reference center.

We conducted statistical analysis to compare data between the judges. As a result that variables were not normally distributed, nonparametric analyzes were performed. Intraclass correlation showed a strong interobserver agreement (0.99) between the judges, thus the mean of the results were calculated. The Spearman´s rank correlation coefficient test was applied between oral and pharyngeal transit times.

RESULTS

Of the 17 individuals in G1, 7 presented IPR up to 250 ms and 10 with IPR greater than 250 ms. In relation to PTT, 6 individuals had PTT up to 1000 ms and 11 with PTT greater than 1000 ms (Chart 1). The results showed that there was no correlation between G1 and a initiation time of pharyngeal response and pharyngeal transit, respectively, of -0.07 and -0.27 (Table 1).

In G2, which consisted of 44 individuals, 11 had SPR up to 250 ms and 33 with SPR greater than 250 ms. Regarding PTT, 12 individuals had TTF up to 1000 ms and 32 with PTT greater than 1000 ms (Chart 1). In this study, there was a weak correlation between G2 and the parameters studied, respectively, 0.38 and 0.35 (Table 1).

Table 1. Correlation of G1 and G2 with initiation of pharyngeal response and pharyngeal transit time

Group	Correlation between groups		
	Individuals	TTOT – IPR	TTOT – PTT
		Spearman	Spearman
G1	17	0,07	-0,27
G2	44	0,38	0,35

Note: TTOT = total oral transit time; IPR = initiation of pharyngeal response; PTT = pharyngeal transit time; G1 = Group 1; G2 = Group 2

DISCUSSION

This study showed that there was no correlation between normal TOTT with initiaton of oropharyngeal response time and PTT; however, there was weak correlation between increased TTOT and increased PTT.

The lack of correlation in the group with normal TTOT with the time of IPR and PTT shows that the oral phase of swallowing within the normal range does not cause an increase or decrease in the pharyngeal phase of swallowing time. The literature discusses the alterations in the times of swallowing phases in healthy individuals and those with neurological disorders, as well as the influence of bolus properties (taste, temperature, consistency) at the time of swallowing phases[8,25].

As to correlation in the group with increase TTOT, although weak, with PTT in the stroke individual means that possible changes in oral transit time can in some way influence the pharyngeal stage of swallowing and, specifically in this population, promote changes in swallowing that can affect both the efficiency and the safety of feeding[26].

The studies in the literature did not investigate the same research hypothesis using a similar method, however, there are studies who have qualitatively studied the correlation between the phases of swallowing and concluded that the organization of the oral phase influences not only the quality of oral propulsion, but also the effective dynamics of the pharyngeal phase[12]. Moreover, the literature has demonstrated that the increase in time in the oral phase causes delay in the initiation of pharyngeal response in swallowing in stroke individuals when compared to normal individuals, particularly in solid and puree consistency[13,26].

Another important factor, which although not part of the objective of this study, deals with the hypothesis on the influence of the increase of times in the phases of swallowing would have on the risk of bronchoaspiration and malnutrition in that population. Studies with both distinct and child populations have shown that when the time in the oral phase is increased, oral ingestion becomes compromised and may cause negative impact on nutritional status[27,28].

One limitation of this study was the small number of individuals in the groups and this may have compromised the correlation index. Future studies could, beyond increasing the number of cases selected for study, compare the oropharyngeal transit time parameters and nutritional factor.

CONCLUSION

The increase of TOTT in the stroke individual has weak correlation with increased time in the pharyngeal phase.

Chart 1. Distribution of individuals according to group

Groups	n	IPR < 250 ms	IPR > 250 ms	PTT < 1000 ms	PTT > 1000 ms
G1	17	7	10	6	11
G2	44	11	33	12	32

Note: IPR = initiation of pharyngeal response; PTT = pharyngeal transit time; G1 = Group 1; G2 = Group 2

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Appendix 1. Demographic and clinical aspects of the individuals

N	Sex	Age	Laterality	Ictus	CT
1	M	65	R. handed	8	Yes
2	M	58	R. handed	24	Yes
3	M	79	R. handed	28	Yes
4	F	57	R. handed	4	Yes
5	M	48	R. handed	8	Yes
6	F	46	R. handed	1	Yes
7	M	76	R. handed	1	Yes
8	F	48	R. handed	2	Yes
9	M	77	R. handed	30	Yes
10	F	77	R. handed	2	Yes
11	M	55	R. handed	5	Yes
12	M	64	R. handed	13	Yes
13	M	64	R. handed	9	Yes
14	F	85	R. handed	8	Yes
15	M	68	R. handed	6	Yes
16	F	71	R. handed	7	Yes
17	M	55	R. handed	6	Yes
18	M	63	R. handed	9	Yes
19	F	72	R. handed	4	Yes
20	F	59	R. handed	5	Yes
21	F	41	R. handed	2	Yes
22	F	88	R. handed	3	Yes
23	M	74	R. handed	17	Yes
24	F	66	R. handed	3	Yes
25	M	68	R. handed	0	Yes
26	M	65	R. handed	2	Yes
27	F	44	R. handed		Yes
28	F	71	R. handed	2	Yes
29	F	67	R. handed	6	Yes
30	M	53	R. handed		Yes
31	F	68	R. handed	8	Yes
32	F	67	R. handed	30	Yes
33	F	61	R. handed	9	Yes
34	F	47	R. handed	22	Yes
35	M	86	R. handed	3	Yes
36	F	70	R. handed	17	Yes
37	F	67	R. handed	28	Yes
38	F	68	R. handed	12	Yes
39	F	81	R. handed	22	Yes
40	F	67	R. handed	19	Yes
41	M	66	R. handed		Yes
42	F	51	R. handed	10	Yes
43	F	65	R. handed	2	Yes
44	M	67	R. handed	21	Yes
45	F	40	R. handed	8	Yes
46	F	75	R. handed	5	Yes
47	F	101	R. handed	0	Yes
48	F	41	R. handed	4	Yes
49	M	71	R. handed	8	Yes
50	M	78	R. handed	1	Yes
51	M	64	R. handed	15	Yes
52	M	55	R. handed		Yes
53	M	73	R. handed	12	Yes
54	F	63	R. handed		Yes
55	F	60	R. handed		Yes
56	M	67	R. handed	6	Yes
57	M	81	R. handed	3	Yes
58	F	59	R. handed	13	Yes
59	M	64	R. handed		Yes
60	M	54	R. handed	12	Yes
61	F	80	R. handed		Yes

Note: N = number of individual; R. handed = right-handed; CT = computed tomography