Reflexo da deglutição: análise sobre eficiência de diferentes estímulos em jovens sadios***

Swallowing reflex: analysis of the efficiency of different stimuli on healthy young individuals

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Abstract

Background: the absence or delay of the swallowing reflex is considered a significant sign of dysphagia. Therefore, the therapy traditionally applied to these cases consists in increasing the intra-oral input through cold touches (0 or 00 larynx mirror) on the inferior portion of the inferior third of the palatoglossus arch. Aim: to identify in healthy young individuals which oropharyngeal regions are more sensitive and which stimulus is more efficient in triggering the swallowing reflex. Methods: the swallowing reflex was analyzed based on the following stimuli: spatula, cold 00 larynx mirror, gauze embedded in cold water wrapped onto spatula and frozen moist gauze wrapped onto spatula; touching the palatoglossus arch in both its inferior and superior portions, the palatine tonsils, the base of the tongue and the uvula in 65 healthy young individuals. Results: the swallowing reflex was not triggered in most of the participants when touching different oropharyngeal regions with different stimuli. This result was statistically significant. When present, the most efficient stimuli were cold 00 larynx mirror (28.6%) and frozen moist gauze wrapped onto spatula (27.3%). Concerning the oropharynx, the uvula (29.6%), the palatine tonsils (26.7%), the superior (25%) and inferior (21.2%) palatoglossi arches and the base of tongue (25%) were most sensitive to the applied stimuli. Conclusion: when the swallowing reflex was present, the uvula, the palatoglossi arches and the palatine tonsils were the most sensitive regions to trigger this reflex, and the most efficient stimuli to trigger swallowing were the cold 00 larynx mirror and the frozen moist gauze wrapped onto spatula.

Key Words: Deglutition Disorders; Deglutition; Physiology; Reflex.

Resumo

Tema: a ausência ou atraso do reflexo da deglutição é considerado um sinal significativo de disfagia. Assim, a terapia tradicionalmente empregada nesses casos consiste em aumentar o *input* intra-oral por meio de toques gelados (espelho laríngeo 0 ou 00) no terço inferior do arco palatoglosso, porção inferior. Objetivos: identificar, em indivíduos jovens e sadios, quais regiões da orofaringe são mais sensíveis para desencadear o reflexo da deglutição e qual estímulo é mais eficiente. Método: O reflexo da deglutição foi investigado a partir dos estímulos: espátula, espelho laríngeo 00 gelado, espátula envolta em gaze com água gelada e espátula envolta em gaze umedecida congelada, tocando-se o arco palatoglosso em suas porções inferior e superior, as tonsilas palatinas, a base de língua e a úvula em 65 indivíduos jovens e sadios. Resultados: o reflexo da deglutição não foi desencadeado na maioria dos participantes quando tocado com diferentes estímulos e locais da orofaringe, sendo esta estatisticamente significante. Quando presente, os estímulos mais eficientes foram o espelho laríngeo 00 (28,6%) e a espátula envolta com gaze congelada (27,3%). Quanto à região da orofaringe, a úvula (29,6%), as tonsilas palatinas (26,7%), os arcos palatoglossos região superior (25%) e inferior (21,2%) e base de língua (25%) foram sensíveis aos estímulos. Conclusão: quando presente o reflexo da deglutição, a úvula, os arcos palatoglossos e as tonsilas palatinas foram as regiões mais sensíveis para desencadeá-lo e o estímulo mais eficiente, dentre os selecionados, foram o espelho laríngeo gelado e a espátula envolta em gaze umedecida congelada.

Palavras-Chave: Transtornos da Deglutição; Deglutição; Fisiologia; Reflexo.

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Introduction

It is discussed in the literature that the pharyngeal phase of the deglutition is a reflex, unconscious act and the reflex that initiate this phase is elicited by touching on determined regions of oropharynx (palatoglossal arch, palatine tonsil, uvula and base of tongue). For such, events that require coordination and fast succession occur in order to protect the airway (1).

The delay or absence of the deglutition reflex (DR) is considered a sign of oropharyngeal dysphagia. The traditionally used therapeutical technique consists on increasing the intra-oral input by means of cold touches (with larynx mirror 0 or 00) on the inferior third of the palatoglossal arch. The justification to stimulate such area is the fact of this being the most sensible anatomical region to initiate deglutition under light pressure (2).

When observing the pharyngeal sensitivity, a study (3) questioned if the DR would be necessarily unchained in the palatopharyngeal archs, therefore it is known that several other points in oropharynx, with greater or minor sensitivity, are capable to elicit this reflex. In this research only two of the 12 patients presented DR in the palatoglossal archs.

Studies (4-5) suggest that in healthy individuals the deglutition reflex phase can be unchained after entrance of food in the pharynx. The pharyngeal phase initiated on the valeculas, posterior wall of pharynx, pyriform sinus or pharynx-esophagus transition may not result in an alteration in healthy individuals, however, in convalescent patients, the aspiration risk is imminent (5).

The relation between the temperature and an efficient deglutition is not known accurately. Watando et al. (6) investigated which temperature would more efficiently elicit the DR in seniors. For such, the reflex was provoked by injecting 1 mL of distilled water in the pharynx between 10° and 80°C in fourteen patients who had suffered stroke. The deglutition was identified as present with the use of a electromyography and visual observation of the larynx rise. The temperatures between 10° and 20°, 60° and 80°C provoked a more efficiently DR, with smaller latency than the temperatures between 30° and 40°C (those approaching to the human body temperature).

The influence of cold stimulation in the palatoglossal archs was analyzed before and after topic anesthesia in 14 healthy young individuals. The response would have to be facilitated by the cold touch and to be inhibited by the local anesthesia since the elicitation of the pharynx deglutition is dependent on the stimulation of receptors in the mucosa of this region. The authors concluded that the pharyngeal phase of the deglutition is not facilitated or inhibited, a priori, for thermal stimulation or topic anesthesia in the palatoglossal archs (7).

Taking into consideration the above, the aims of this study were to identify which oropharyngeal region is more sensible to elicit the reflex of deglutition and which stimulation amongst the selected ones are more efficient.

Methods

This research was conducted after approval by the Committee of Ethics in Research of the Federal University of Minas Gerais (UFMG) under number 223/05 and signature of the Consent Form by all the participants.

Sixty-five volunteers, between 18 and 30 years of age (average of 22,7 years), 23 males and 42 females, with completed or currently coursing college degree were the subjects of this study. The subjects were volunteer students of the UFMG. All the subjects met the following inclusion criteria: age between 18 and 30 years, absence of history of neurological, neuromuscular, gastrointestinal diseases, head and neck cancer, neurological surgery; preserved extra oral sensitivity; absence of complaint and signals of dysphagia; and non use of dental prostheses and medicines that could cause dysphagia as collateral effect. In order to certify the inclusion criteria, the subjects were submitted to screening composed by questionnaire, investigation of collateral effects of medicines in use, evaluation of the organs of the stomatognathic system and functions of mastication and deglutition. Of the 65 participants, nine (five women and four men) did not presented palatal tonsil.

To search for the presence of DR, four different stimulation were selected in order to observe it influence of texture and temperature of the materials:

1. Spatula not involved in any material (E).
2. Cold larynx mirror, number 00 (EL). The mirror was placed inside cold water - being the temperature between 5º and 14ºC, monitored by a thermometer - after about 10 seconds, the structures of oropharynx were touched. To each tested structure, the mirror was submerged again into the water. The mirrors were disinfected with glutaraldeid 2%,

during 30 minutes after the use in each subject;
3. Spatula with gauze wet with cold water (EGG). The gauze was rolled in a half spatula (cut longitudinally) and absorbed in cold water, being the temperature monitored by a thermometer, varying between 5º and 14ºC. The structures to be tested were touched three times and after three touches, the material was submerged on cold water again. After each immersion the excess of the water was removed of the gauze;
4. Spatula rolled with humidified and frozen gauze (EGC). Half spatula was involved in a gauze piece that was absorbed in water and placed in freezer of a refrigerator of the Continental brand, model 270, until freezing. The structures to be tested were touched and at each three touches the gauze was placed over ice in order to keep the temperature of the stimulation - approximately 0ºC.

The oropharynx stimulated places were uvula, palatoglossal archs (inferior and superior portions), palatine tonsils and base of tongue, right and left sides. Three touches of each stimulation were carried through in each structure. Each touch had the duration of approximately 5 seconds, followed by pause between the stimulation (about 20 seconds), in which it was requested to the participant to swallow before the new touch, eliminating the possibility of the necessity of swallowing during the experiment for having saliva in oral cavity or oropharynx.

The DR was considered present when the contraction of the muscles of the palatal veil or the walls of the retractors of pharynx happened or when rise of the larynx, identified by the position of the four fingers in the cervical region occurred. The four fingers of the examiner were maintained in the cervical region during the entire evaluation.

The presence or absence of the DR was considered regarding each material and stimulated region in each subject. The reflex was considered:

1. Present: if the DR occurred in two or three touches in the structure;
2. Absentee: if the individual did not present or presented DR or gag in only one of three touches;
3. Gag Reflex: if there were indications in two or three touches of the occurrence of the gag reflex;
4. Indifferent: when there were indications after a touch of a gag reflex, on a second touch reflex of deglutition and, on a third one, there was no response indicative of any oral reflex.

The observation and search for the DR made by two examiners previously trained, being that one carried through the touches and both analyzed the responses individually and these analysis were later collated; the subjects were seated and the examiners were positioned it front of them.

For statistical analysis the tests of Equality of Two Ratios, having that the responses are qualitative, and Confidence Interval to complement the descriptive analysis were used. The significance level of 5% was adopted.

Results

The total number of responses obtained on all the participants stimulated three times with the four different materials and investigated oropharynx area was 2268.

When touching the oropharynx region using E, the "absent" response was the most frequent one in all oropharynx structures, being this data statistically significant ($p<0,001$) when compared to the other ones. This data indicates to be this the most common response when touching the oropharynx. On the other hand, the "present" response on uvula was statistically significant when compared to "indifferent" answers ($p<0,001$) and "gag reflex" ($p=0,019$) being, therefore, the DR more common than the gag reflex in this region.

When stimulating the structures with EL, once again the "absent" response was significant ($p < 0,001$). The "present" response, in all researched regions - besides the left palatine tonsil - brought the DR to be statistically significant when compared to the "indifferent" ($p < 0,001$) and "gag reflex" ($p = 0,006$). The same occurred with EGG and EGC.

With regards to the most efficient stimulation to unchain the deglutition, the EL, the EGC and the EGG were the ones that obtained better results not being presented statistically significant difference among them (Table 1).

With regards to the most efficient region of the oropharynx to unchain the DR (Table 2), the uvula was the region that presented greater number of "present" responses, followed by palatine tonsils, not having statistically significant difference between these ($p = 0,091$). However, there was a statistically significant difference when comparing the uvula with the right side tongue base ($p=0,035$) and inferior anterior pillar palatoglossal right ($p = 0,020$) and left ($p = 0,027$).

It is necessary to highlight that difference was not observed when comparing the results between genders.

TABLE 1. Response distributions for each stimulation.

Response to the Stimulation	Type of Stimulation							
	Spatula with frozen Gauze		Laryngeal Mirror		Spatula with Cold Gauze		Spatula	
	N	%	N	%	N	%	N	%
Absent	376	66,3	370	65,3	390	68,8	424	74,8
Indifferent	5	0,9	9	1,6	8	1,4	8	1,4
Present	155	27,3	162	28,6	140	24,7	99	17,5*
Gag Reflex	31	5,5	26	4,5	29	5,1	36	6,3
TOTAL	567	100	567	100	567	100	567	100

N = Number, * = Statistically significant values when compared to other variables

TABLE 2. Distribution of responses to each stimulated oropharyngeal region, independent of stimuli used.

Area of stimulation	Response to the Stimulation									
	Absent		Present		Indifferent		Gag Reflex		Total	
	Number	%	Number	%	Number	%	Number	%	Number	%
PT R	129	57,6	60	26,7*	8	3,6	27	12,1	224	100
PT L	130	58,0	60	26,7*	4	1,8	30	13,5	224	100
Uv	169	65	77	29,6*	2	0,8	12	4,6	260	100
TB R	182	70	56	21,5	4	1,5	18	7	260	100
TB L	175	67,3	65	25	2	0,8	18	7	260	100
IPA R	202	77,7	54	20,8	2	0,8	2	0,8	260	100
IPA L	201	77,3	55	21,2	2	0,8	2	0,8	260	100
SPA R	186	71,5	64	24,6	3	1,1	7	2,6	260	100
SPA L	186	71,5	65	25	3	1,1	6	2,5	260	100

TB= Tongue Base, IPA= inferior palatoglossal arch, SPA= superior palatoglossal arch , PT= palatine tonsil, Uv = uvula, R = Right, L = Left, * = Statistically significant values when compared to other variables

Discussion

The DR, the efficiency of its stimulation and the place that unchains it are not widely boarded topics in literature, although its relevance during the deglutition dynamics. Doria et al. (3) cited that the second phase of the deglutition is initiated when the food touches some areas of oropharynx and generates a series of involuntary contractions - the DR.

The delay or absence of this reflex can cause penetration or aspiration of food before the beginning of the pharyngeal phase of deglutition (6). The most difunded and studied therapy found in literature for the treatment of this signal is the tactile-thermal stimulation of the palatoglossal arch

(2, 7-8). It must still be mentioned, the existence of others techniques for this treatment, such as the stimulation of the K-point (9) and the therapy of orofacial regulation (10). The tactile-thermal stimulation was described almost a century ago by Pommerenke (2), however, the efficiency of this intervention as for the appropriate intensity of the stimulation and its effectiveness (12) are still questioned (11).

When analyzing the results of this research, the prevalence of the absent response when touching regions of oropharynx with different materials and temperatures is observed.

Sciortino et al. (8) investigated the efficiency of three stimulations (mechanical, cold and gustatory stimulations) in order to unchain the deglutition. They did not find statistically significant difference among the responses obtained from the three distinct stimulations.

Regarding the areas that had unchained the DR the greatest amount of time, when present, we can highlight the uvula (29.6%) and the palatine tonsils (26.7%), not existing a statistical difference between them. However, other regions of oropharynx had also initiated the pharyngeal phase of the deglutition when touched. They are palatoglossal base of tongue (25%), palatoglossal archs in the superior portion (25%), and palatoglossal arch in the third inferior (21%). These results corroborate with notes of other studies (3, 13) that had suggested the presence of some points in oropharynx, with greater or minor sensitivity, capable to elicit the DR. Studies have emphasized that, in healthy individuals, the deglutition is elicited below the tongue base intersection and in the jaw angle (the height of the palatoglossal archs) without accomplishing the deglutition efficiency (14-16).

When comparing the different stimulation (table 1) - independent of the place touched - it was observed that the cold stimulation was statistically different than the spatula in ambient temperature in the answers "present", showing these to be more efficient stimulation. Percentually the EL was the stimulation that better unchained the reflex (28.6%), followed by the EGC (27.3%). These results coincide with the findings of Watando et al. (6), where they observed to be the different body temperatures the most efficient to unchain the DR.

The deglutition is a continuous and coordinated motor act and the beginning of the second phase of the deglutition can be related to structures beyond those of the oropharynx (1). Thus, during the therapeutical process, the Speech-Language Pathologist will have to attempt against the phenomenon of the deglutition as a whole, therefore when stimulating oropharynx with different stimulation; the DR can not be unchained. However, this technique increases the intraoral perception, serving as an alert mechanism to facilitate deglutition.

It is important to highlight that the gag reflex was observed in all touched places and stimulation used, and its greatest prevalence was present when using the spatula as material. It must be detached that these findings were not statistically significant. The gag and deglutition reflex possess the same motor and sensitive way, although being a phenomena elicited by different stimulation (1) - justifying, thus, the presence of this reflex in this study. The spatula was the material that, numerically (6.3%), had more provoked this reflex. The physical nature of the stimulation and psychological attitude of the individual before the presented material can justify this fact.

Finally, it is believed that the investigation of the DR presence from the touches in oropharyngeal region is facultative in the process of Speech-Language Pathology evaluation. It has to be intent as the dynamics of the deglutition as a whole, observing its integrity and the inter-relations of the deglutition phases during food and saliva ingestion.

Investigation of the efficiency of thermal stimulation in individuals with impairments in the start of the DR is suggested as well as more adequate intensity and frequency of stimuli is necessary once this technique is benefic to some patients in clinical practice. Moreover, it is suggested that the practice of thermal stimulation during rehabilitation should occur, preferably with cold stimulation, always vinculated to the deglutition act and, when possible, with foods, in order to optimize the oropharyngeal sensorial input and consequently to elicit the DR entailed to the function.

Conclusions

It can be concluded that, in young individuals, without dysphagia, the DR was not present in the majority of the experimental touches carried through in oropharynx with different materials, not being this one, therefore, the most indicated manner to investigate oropharyngeal sensitivity for the DR. However, in order to maximize the sensorial input, the cold stimulation presented better responses than the stimulations close to body temperature, especially on the uvula, palatine tonsils and palatoglossal archs in its superior portion.

References

1. Koch WM. Swallowing disorders. Med Clin North Am. 1993;77:571-82.

2. Pommerenke WA. A study of the sensory areas eliciting the swalowing reflex. Amer J Physiol. 1928;84:36-41.

3. Doria S, Abreu MAB, Busch R, Assumpção R, Nico MAC, Ekcley CA, et al. Estudo comparativo da deglutição com nasofibrolaringoscopia e videodeglutograma em pacientes com acidente vascular cerebral. Rev Bras Otorrinolaringol. 2003;69:636-42.

4. Dua KS, Ren J, Bardan E, Xie P, Shaker R. Coordination of deglutive glottal function and pharyngeal bolus transit during normal eating. Gastroenterology. 1997;112:73-83.

5. Saitoh E, Shibata S, Koichiro M, Baba M, Fujii W, Palmer JG. Chewing and food consistency: effects on bolus transport and swallow initiation. Dysphagia. 2007;22:100-7.

6. Watando A, Ebihara S, Okazaki T, Tajahashi H, Asada M, Sasaki H. Effect of temperature on swallowing reflex in elderly patients with aspiration pneumonia. J Am Geriatr Soc. 2004;52:2143-4.

7. Ali GN, Land TM, Wallace KL, DeCarle DJ, Cook IJS. Influence of cold stimulation on the normal pharyngeal swallow response. Dysphagia. 1996;11:2-8.

8. Sciortino KF, Liss JM, Case JL, Gerrirsen KGM, Katz RC. Effects of mechanical, cold, gustatory and combineted stimulation to the human anterior faucial pillars. Dysphagia. 2003;18:16-26.

9. Kojima C, Fujishima I, Ohkuma R, Maeda H, Shibamoto I, Hojo K, et al. Jaw opening and swallowing triggering method for bilateral-brain-damage patients: K-Point stimulation. Dysphagia. 2002;17:273-7.

10. Hägg M, Larsson B. Effects of motor and sensory stimulation in stroke patients with long-lasting dysphagia. Dysphagia. 2004;19:219-30.

11. Rosenbek JC, Robbins J, Fishback B, Lecine RL. The effects of thermal aplication on dysphagia after stroke. J Speech Hear Res. 1991;34:1257-68.

12. Power ML, Fraser CH, Hobson A, Sinch S, Tyrrell P, Nicholson DA, et al. Evaluating oral stimulation as a treatment for dysphagia after stroke. Dysphagia. 2006;21:49-55.

13. Ertekin C, Kiyliogli N, Tarlaci S, Turman B, Secil Y, Ayodogdu I. Voluntary and reflex influences of initiation of swallowing reflex in man. Dysphagia. 2001;16:40-7.

14. Stephen JR, Taves DH, Smith C, Marim R. Bolus location at the initiation of the pharyngeal stage of swallowing in healthy older adults. Dysphagia. 2005;20:266-72.

15. Daniels SK, Schoroeder MF, DeGeorge PC, Corey DM, Rosenbek JC. Effects of verbal cue on bolus flow during swallowing. Am J Speech Lang Pathol. 2007;16:140-7.

16. Martin-Harris B, Brodsky MB, Michel Y, Lee F, Walters B. Delayed initiation of the pharyngeal swallow: normal variability in adult swallows. J Speech Hear Res. 2007;50:585-94.