Performance of Brazilian elderly on the 100 ml water swallowing test

Desempenho de idosos brasileiros no teste de deglutição de 100 ml de água

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ABSTRACT

Purpose: To compare the performance of Brazilian elderly patients living in a long-term care facility on the 100 ml water swallowing test with the results obtained with British elderly. **Methods:** Eighteen elderly subjects (13 women and five men, mean age 83.46), residents in a long-term care facility and considered normal regarding the swallowing function, were selected to take part in this study. As in a British study, they were laterally observed by the examiner while swallowing 100 ml of water from a plastic cup. The examiner observed the number of sips, the time taken, and complications during the test, which generated the following indices: volume per swallow (ml), time per swallow (s), and swallowing capacity (ml/s). **Results:** The elderly men had lower swallowing capacity than the women in the research, oppositely from the original British study. The mean time per swallow and the mean volume per swallow were similar for both genders. **Conclusion:** The swallowing capacity in elderly subjects is lower than that of normal adults, suggesting slowing in the deglutition process. The difference between genders reported in the original study was not found in the present study; however, our sample was older.

Keywords: Deglutition; Deglutition disorders; Health services for the aged; Swallowing disorders; Homes for the aged

INTRODUCTION

Dysphagia is a symptom that affects any of the three phases of swallowing in about 40% of the adults over 65 years, reaching 60% when it comes to institutionalized elderly. Among other aspects, the high prevalence of dysphagia in the elderly is due to related diseases and increased use of medicines. Swallowing becomes less efficient with aging, and the elderly individual becomes more susceptible to dysphagia secondary to other diseases, such as those that affect the central nervous system (CNS) or the esophagus[1-3].

A recent American study conducted with elderly subjects who were independent or who needed small assistance in daily living activities, all of them non-institutionalized and without any history or clinical complication, showed that 15% of them reported moderate to severe difficulty in feeding, when asked in self-assessment questionnaires[4].

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According to several authors, physiologically, the swallowing of elderly individuals can be characterized by problems in oral, pharyngeal and/or esophageal phases. Chart 1 shows the effects of age over the physiology of swallowing. At the CNS level, changes in the neuronal central-peripheral transmission and its conection with motor units of swallowing are considered part of physiological aging[1,5].

Dysphagia can cause drop of food from the oral pathway into the airway, characterizing penetration (above vocal folds) or aspiration (below vocal folds), and lead to the development of aspiration pneumonia, recognized, especially among the elderly, as a threat to life with mortality rates that can reach 60%. Several author have reported that about 40% of the victims of aspiration pneumonia may not show any clinical signs of aspiration, which characterizes silent aspiration[6-8].

The videofluoroscopy is the current gold standard for dysphagia assessment, identifying anatomical or functional abnormalities and determining safe conditions for feeding. However, it is not always feasible, considering medical, logistical and financial factors[9,10].

The development of bedside behavioral methods to detect swallowing abnormalities, with sensitivity and specificity compatible with the high risk of aspiration, pulmonary complications and morbidity in the elderly, is a lacking field in scientific research, because in spite of numerous studies, there is no consensus yet.

Chart 1. Swallowing problems in the aging process

Phase	Effects of aging in swallowing function	Consequences
Oral	Prolongation of the preparation stage Decrease in lingual force and mobility Loss of natural teeth and dentures with imperfect fit Loss of masticatory bite force	Tiredness during feeding
	Reduction of tongue papillae and sense of smell	Impairment of afferent sensory
	Xerostomy by salivary gland hypofunction or side effects of drugs	Increased effort and delay
Pharyngeal	Increasing pressure threshold required to recognize the bolus	Laryngeal aspiration by increasing the bolus needed to trigger the swallowing reflex
	Reduction in muscle tissue supra and infra-hyoid, which supports the larynx	Reduced laryngeal elevation and anteriorization affecting the protection of airways
	Reduction in the aperture of upper esophageal sphincter, due to reduced laryngeal elevation	Slowing of swallowing
Esophageal	Thickening of the involuntary esophageal muscles and reduction in the amplitude of peristaltic contraction	Delayed esophageal emptying causing its distention
	Reduction in the resting pressure of pharyngoesophageal segment	Increased risk of reflux

Adapted from: Feijó AV, Rieder CR. Distúrbios da deglutição em idosos. In: Jacobi JS, et al. organizador. Disfagia – avaliação e tratamento. Rio de Janeiro: Revinter; 2003.p 225-32[1].

Scientific studies admit that if a patient is observed drinking a fixed volume of water, apart from some qualitative aspects (such as slowing, coughing, altered voice quality, chocking), quantitative aspects (called swallowing indices: volume per swallow, time per swallow, and swallowing capacity) can also be measured at bedside and with easy accessed technology, helping the clinical judging regarding severity of dysphagia, aspiration risk, complications, and monitoring of cases. For normal elderly, such as the subjects in this study, these researches have shown that there is a clear decline with advanced age in the volume per swallow (VS) and the swallowing capacity (SC), as well as an increase in the time per swallow (TS). The original study[11], with which our data is compared, describes the performance of 181 individuals, between normal subjects and patients with motor neuron disease, with ages between 18 an 91 years, in the 100 ml water swallowing test (WST). Twenty-two individuals, 12 men aged 75 to 87 and mean age 77.3 years and ten women aged 75 to 91 and mean age 79.9 years, were evaluated, and the values of VS, TS and SC were determined.

The swallowing indices, alone, provide little information about the severity of the primary disease, but provide indications about the level of disability that it causes in the individual. With a mandatory observation of swallowing, this test ensures that the neurological examination is based in a functional assessment of the patient's swallowing.

For adults under 70 years, swallowing capacity below 10 ml/s was strongly associated with abnormal swallowing, with sensitivity ranging from 47 to 97% and specificity between 67 and 88% in different studies[2,12]. Problems in awareness or understanding the explanation may affect the reliability. In addition, the test can be potentially hazardous for patients with suspected silent aspiration, aspiration, or lung problems, since it requires the swallowing of small portions of liquid.

Many procedures designed to detect swallowing problems at bedside may have low sensitivity and specificity when taken alone, but, if combined, result in values more compatible to the high risk posed by silent aspiration. The combination between the 100 ml WST and pulse oximetry, in a recent Japanese study, showed 100% of sensitivity and 70.8% of specificity[13].

The 100 ml WST proposed in the original study[11] and reproduced in the present research results in a measure to quantify changes in swallowing over time. Thus, an individual standardization might allow that the test is used to monitor the patient, by comparing data of the same subject in different moments.

Further investigation could also indicate whether and how abnormal responses would determine indication for early clinical interventions. It could also have the property to analyze the predictive value of the swallowing indices for morbidity due to pulmonary and nutritional complications.

The aim of this study was to apply the 100 ml WST in Brazilian institutionalized elderly individuals without dysphagia complaints, in order to compare their performance with the results obtained in British elderly[11].

METHODS

Subjects

Among the elderly residents at the facility where the research was developed, we excluded those under 75 years, those who had already been referred to speech-language therapy due to swallowing problems, those who had any diagnosis that could have relevant consequences to swallowing (such as neurological disorders, head and neck surgery, respiratory and digestive diseases), and a newly admitted elderly individual, still undiagnosed, in order to create a group with a similar profile to the elderly group in the original study. Among the

subjects who met the inclusion criteria, 20 were randomly selected and asked to participate willingly in the research by signing the free and informed consent form. Two men refused to participate, hence participants were 13 women and five men, mean ages 84.9±8.9 and 82±7.5 years, respectively.

Before the assessment, they were answered the question: "Do you have any difficulties with your swallowing?" (none answered yes), and then the test was performed as it follows.

Procedures

Subjects were asked to drink as fast as comfortably possible a volume of 100 ml of water from a plastic cup. The researcher observed laterally, counting the number of swallows by the upward movements of the thyroid cartilage and clocking the time elapsed from the moment the water touches the upper lip until the moment when the larynx returns to the rest position for the last time (usually accompanied by expiration, phonation or opening the mouth). Cough, hawk, pauses, changes in vocal quality, or non-completion of the swallowing task were noted and, in the last case, the volume swallowed was obtained by deduction of the remaining volume in the cup.

The test was repeated after five minutes with another 100 ml of water and a new measurement of time. After one week, another stage was completed, totalizing four measurements for each subject, and allowing reproducibility of the findings. The same researcher collected all data, faithfully reproducing the conditions and procedures described in the original study[11].

The variables considered in the original study[11], called "swallowing indices", were: 1) volume per swallow (VS), i.e., the amount of water swallowed in each sip (in ml); 2) time per swallow (TS), i.e., time spent to capture, organize and swallow each sip (in s); and 3) swallowing capacity (SC), i.e., the speed at which the subject is capable to swallow a given volume, in a comfortable and safe manner (in ml/s).

This study had the approval of the Ethics Committee of *Casa Gerontológica de Aeronáutica Brigadeiro Eduardo Gomes* – CGABEG, registered in the National Research Ethics Committee (*Comitê Nacional de Ética em Pesquisa* – CONEP), under registration number: CEP – Memo – no. 15/04.

RESULTS

The results obtained in this study are compared with those of the original study in Table 1. Table 2 shows individual data, including complications.

The mean SC for male subjects was 7.74 ml/s (Figure 1). Only one subject out of five had SC above 10 ml/s. The lowest SC was observed in the older man (92 years old), who also presented higher number of illnesses, noise during swallowing, and hawk after it.

In the female group, the mean SC was 8.73 ml/s (Figure 2). Five of 13 had a score above 10 ml/s. The lowest SC was also found in the older subject (103 years old), who, in the second part of both days of testing, could not drink all the water offered, accepting respectively 90 and 40 ml. The test-retest response for this subject was consistent.

The mean TS was 1.8 s, and the mean VS was 14 ml, numbers remarkably homogeneous between men and women.

Despite the greater variability found in the female group, given by higher standard deviation values, there were no important differences between genders for any of the three swallowing indices. One must consider that the female sample was much larger than the male in the present study, reflecting the reality of long-stay facilities for elderly.

In comparison to data from the original study, the age group of the normal elderly in this study was larger and included older individuals.

DISCUSSION

In the original study, it was established that decrease in the SC can be due to reduction of the mean volume of bolus, to the prolongation of each swallow, or to a combination of both[11]. Breathing pauses would increase the mean TS without affecting the volume of bolus, which would make this the most appropriate parameter to estimate the swallowing function alone.

In fact, in our study we observed that the volume varied more than time, leading to a difference in the SC that matched men and women.

Inclusion criteria were very strict, which explains the little interference of difficulties in other functions, such as breathing, and, therefore, less variation in the TS.

Thus, the volume assessment objectively reflected the conditions of swallowing, and it was the point where our findings differed from literature data, where quantitative and gender differences were not found.

Table 1. Comparison of normal elderly on the 100 ml water swallowing test

Variável	Original study[11]		Present study	
	Male	Female	Male	Female
Age range (years)	75 a 87	75 a 91	76 a 92	76 a 103
Time interval (years)	12 anos	16 anos	16 anos	27 anos
Mean age (years)	77.3	79.9	82±7.5*	84.9±8.9*
Number of subjects (n)	12	10	5	13
Mean volume per swallow (ml)	20.0	10.6	14.2±4.55*	14.3±6.17*
Mean time per swallow (s)	1.5	1.5	1.8	1.8
Swallowing capacity (ml/s)*	14.6±5.9*	7.5±3.3*	7.7±2.67*	8.7±4.33*

* Mean±standard deviation

Table 2. Individual results

Subject	Gender	Age (years)	Number of natural teeth	Number of diagnoses	Number of medicines in use	Mean volume per swallow (ml)	Mean time per swallow (s)	Swallowing capacity (ml/s)	Complications
1. G.N.	M	78	0	5	9	15.07	2.24	6.68	Head tilt back
2. H.A.	M	76	18	3	2	11.56	1.52	7.61	-
3. J.A.	M	88	4	4	3	17.74	1.52	11.88	-
4. T.C.	M	76	18	2	1	18.99	2.36	7.98	Oral leak
5. U.M.	M	92	0	6	4	7.88	1.77	4.54	Hawk, pause
6. A.M.	F	96	0	3	3	8.39	1.58	5.33	Oral leak
7. A.C.	F	84	11	6	9	20.00	1.42	14.27	Oral leak
8. D.R.	F	82	7	4	6	21.25	1.44	14.92	Oral leak
9. E.R.	F	103	6	3	3	6.10	4.11	1.49	Hawk, pause
10. H.C.	F	92	9	3	5	25.00	1.88	13.45	-
11. J.S.	F	79	10	5	3	16.31	2.13	7.94	Oral leak
12. J.L.	F	77	13	3	1	21.07	1.66	13.20	-
13. L.L.	F	78	8	1	4	10.00	1.93	5.28	-
14. M.L.	F	77	0	3	4	7.99	1.39	5.99	Pause
15. M.P.	F	90	0	5	7	11.30	1.86	6.22	Oral leak
16. N.C	F	76	4	4	3	18.34	1.52	12.11	-
17. R.P.	F	93	2	5	1	9.41	1.80	5.38	-
18. Y.F.	F	77	5	2	1	12.25	1.54	8.10	-

Note: M = male; F = female

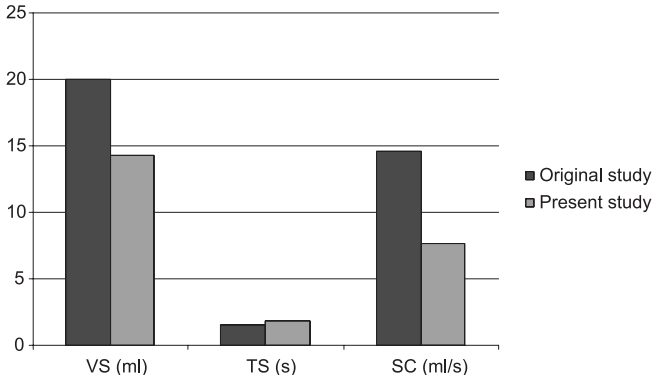

Figure 1. Comparison between men in both studies

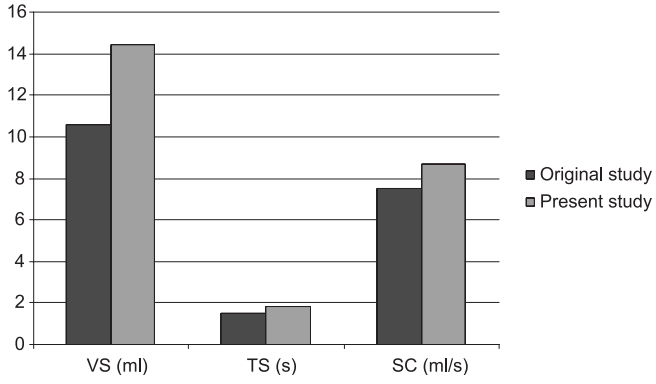

Figure 2. Comparison between women in both studies

This disparity can be justified by data from several authors who claim that aging determines a decline in the VS and the SC, and an increase in the TS. They also postulate that the normal cut point for adults under 70 years for the SC is 10 ml/s[11,12,14].

The sample in our study are older than the elderly from the comparative study, which makes these results somehow pioneers, but following the trend indicated in the literature regarding what was found among men, i.e., aging causing decrease in swallowing indices.

Despite the small number of participants, especially in the male group, this study may indicate that, for a very old age, the normal indices for both men and women tend to be matched at about 7 ml/s.

Among women who had SC below 7 ml/s, it was observed signs such as oral leak, pauses, hawk and difficulty in accepting the offered amount of liquid.

In the male group, in which two had SC below 7 ml/s, we found compensations (head tilt back), pause, hawk, noise during swallow, and polypharmacy.

With this explanation, we suggest that the SC below 7ml/s was associated with signs and symptoms of risk for dysphagia and, therefore, this finding could indicate that the elderly, even without complaints or more severe symptoms, should be referred to speech-language therapy to prevent dysphagia and its possible complications.

The 100 ml WST is more reliable than the patient's complaint, which is consistent with our findings, since, among

patients who met our inclusion criteria and agreed to participate in this research, none reported difficulty to swallow, but eight had SC below 7 ml/s[11].

In our findings, reductions in the SC were due to an increase in the number of swallowing combined with a decrease in the VS. The reasons for the slowing of swallowing with aging are: natural caution, local factors (dentures, oral or pharyngeal disorders), cervical, respiratory or neurological problems, over-medication, lowered consciousness, and lowered comprehension.

In addition, we observed that six women reported that two portions of 100 ml of water in five minutes was an excessive amount of water to drink, which leads to the delicate issue of dehydration in elderly.

The difference in SC between genders was not reproduced in the present study; however, our age group was larger, which means that we studied an older, heterogeneous and rare population in Brazil, in terms of long-term institutionalized elderly.

The application of the test and data collection/analysis did not present any difficulty, proving to be an easy to replicate, quick and inexpensive method to assess the swallowing function at bedside. Only two male subjects refused to participate in the study.

Further studies with a larger number of participants are needed so that a statistical method can be used to indicate the significance of the results.

CONCLUSION

When compared to the original study, the results did not replicate the expected gender differences. For very elderly institutionalized individuals, the differences between genders were lower in all three swallowing indices, matching the genders.

Preliminarily, while the literature points 10 ml/s as a normal SC for adults, our results suggest that this value may be around 7 ml/s for the tested population: Brazilian normal institutionalized elderly.

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RESUMO

Objetivo: Comparar o desempenho de idosos brasileiros, residentes em uma instituição de longa permanência, no teste de deglutição de 100 ml de água com os resultados obtidos em idosos ingleses. **Métodos:** Dezoito idosos residentes numa instituição de longa permanência, considerados normais para a função de deglutição (13 mulheres e cinco homens, com idade média de 83,46 anos) foram solicitados a beber 100 ml de água de um copo plástico, reproduzindo o estudo inglês. O avaliador observou lateralmente o número de goles, tempo gasto e intercorrências, gerando três índices: volume por deglutição (ml), tempo por deglutição (s) e capacidade de deglutição (ml/s). **Resultados:** A capacidade de deglutição para homens foi menor do que a das mulheres, divergindo do estudo original. O tempo médio de cada deglutição e o volume médio por deglutição foi semelhante para ambos os gêneros. **Conclusão:** A capacidade de deglutição em idosos é inferior à de adultos normais, indicando lentificação da deglutição. A diferença entre gêneros encontrada no estudo original não foi reproduzida, entretanto nossa amostra foi mais idosa.

Descritores: Deglutição; Transtornos de deglutição; Serviços de saúde para idosos; Transtornos de deglutição; Instituição de longa permanência para idosos

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