Avaliação da deglutição de idosos com indicação de revascularização miocárdica****

Assessment of the swallowing function in older individuals referred to myocardial revascularization surgery

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Abstract

Background: swallowing evaluation of older individuals with coronary disease referred to heart surgery. Aim: to identify the characteristics of the swallowing function in older individuals referred to myocardial revascularization surgery (MR), using an evaluating protocol composed by a water test, cervical auscultation and pulse oximetry. Method: the Assessment Protocol for Dysphagia Risk through a Combined Swallowing test and Vital Signs monitoring was used (PADTC) - measurements of HR and SpO2 (heart rate and oxygen saturation), water swallowing test with 1, 3, 5, 10, 15 e 20ml, measurement of respiratory rate and cervical auscultation. The electronic stethoscope was used to analyze the number of swallows, response time and swallowing sound classification. In the Research Group (RG) older individuals with heart disease who were referred to MR were included. In the Control Group (CG) healthy older individuals were included. Results: 38 older individuals were evaluated in the RG (mean age 68 years). In the CG, 30 older individuals were evaluated (mean age 70 years). There was a significant difference for the swallowing response time in older individuals with heart disease who presented HR below 60: swallowing response was shorter for 3ml, 10ml, 15ml e 20ml. HR was lower for individuals with heart disease. No significant difference was found between the groups for the other analyzed parameters. Conclusion: older individuals with heart disease presented differences in the swallowing function when compared to healthy older individuals. Older individuals with heart disease presented alterations in the temporal coordination between breathing and swallowing, thus indicating risk for dysphagia.

Key Words: Deglutition; Aged; Myocardial Infarction; Oximetry; Dysphagia.

Resumo

Tema: avaliação da deglutição de idosos com doença coronária e indicação de cirurgia cardíaca. Objetivo: identificar as características da deglutição de idosos indicados à cirurgia de Revascularização Miocárdica (RM), utilizando um protocolo de avaliação composto por um teste de deglutição água, ausculta cervical e registros da oximetria de pulso. Método: foi utilizado o Protocolo de Avaliação do Risco de Disfagia por Teste Combinado de Deglutição e Monitorização dos Sinais Vitais (PADTC), contendo o registro da FC e SpO_2 (frequência cardíaca e saturação de oxigênio), um teste de deglutição de água com 1, 3, 5, 10, 15 e 20ml, medida da frequência respiratória e ausculta cervical. O estetoscópio eletrônico propiciou a análise do número, tempo de resposta e classificação do som da deglutição. No Grupo de Pesquisa (GP) foram incluídos idosos cardiopatas com indicação de RM. No Grupo Controle (GC) foram incluídos idosos saudáveis. Resultados: foram avaliados 38 idosos no GP, com média de idade de 68 anos. No GC foram avaliados 30 idosos, com idade média de 70 anos. Houve diferença significativa no tempo de resposta da deglutição nos cardiopatas com FC abaixo de 60, sendo mais curto em 3ml, 10ml, 15ml e 20ml. A FC permaneceu mais baixa nos cardiopatas. Não houve diferença significativa nos outros parâmetros, ou seja, os dois grupos foram semelhantes. Conclusão: os idosos cardiopatas apresentaram diferença na função de deglutição em relação aos idosos saudáveis. Os cardiopatas apresentam alterações da coordenação temporal entre respiração e deglutição, revelando risco para a disfagia.

Palavras-Chave: Deglutição; Idoso; Infarto do Miocárdio; Oximetria; Disfagia.

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Introduction

Patients who have had cardiac surgeries are typically at an advanced age and present a larger number of associated conditions. The cardiac surgery most frequently performed in elderly patients is myocardial revascularization (MR). This surgery is indicated in the treatment of coronary artery disease (CAD), in which the obstruction of coronary arteries by atheroma plaques may cause acute myocardial infarction (AMI). The risk for complications after MR has been investigated in this population, and strategies have been proposed to decrease the morbidity and mortality1,2.

Oropharyngeal dysphagia (OD), or swallowing disorder, affects elderly patients who suffered cardiac surgeries, increasing the risk of aspiration, respiratory complications, and pneumonia. Studies have shown that the index of pulmonary complications and death in elderly patients who are in the intensive care unit (ICU) are reduced when OD is detected early3-7.

The objective of the current study was to identify the characteristics of swallowing in elderly patients with CAD and indication for MR, utilizing an evaluation protocol that consists of a water swallowing test with cervical auscultation and pulse oximetry assessment.

Methods

The selection and evaluation procedures followed the relevant ethics processes: Ethics Committee approval (CAPPesq HCFMUSP number 807/06) and signature of informed consent.

Subjects

Study Group (SG): participants of this group were selected from the list of patients eligible for MR surgery in a cardiology referral hospital. The subjects were admitted in the hospital ward in preparation for elective MR, with length of stay ranging from 24 to 48 hours. Medical records were accessed to review overall clinical assessment data; independent activities of daily living (ADL); cognitive functions; and previous and current diseases. The eligibility criteria were: age equal to or greater than 60 years old; both genders; with indication of elective MR; with no history of previous cardiac surgery, respiratory diseases, gastrointestinal diseases, or neurological diseases; and with no history of oropharyngeal or laryngeal tracheal surgery. Data regarding independent ADL and cognitive functions must have been recorded within a maximum of 48 hours. Thirty-eight elderly met the inclusion criteria.

Control Group (CG): the subjects in this group were volunteers selected among individuals who were not admitted in the hospital but registered in the Geriatrics Ambulatory of a general hospital. The inclusion criteria for this group included the following: age between 60 and 75 years old; both genders; with no history of respiratory diseases, gastrointestinal diseases, cardiac diseases, or neurological diseases; with no history of oropharyngeal or laryngeal tracheal surgery; and with no hospital admission in the past 12 months. Data regarding independent ADL and results of the mini-mental state examination (compatible with the individual's age and education level) should have been collected within a maximum of 60 days. Thirty elderly met the inclusion criteria for this group and signed the informed consent.

Materials

The study employed the Evaluation Protocol of Risk for Dysphagia by Combined Swallowing Test and Vital Signs Monitoring (EPDCT)8.

The materials used in the study were: a disposable cup with 60 mL of filtered water, disposable 20 mL syringe, electronic stethoscope Littmann 4100 (3M Health Care), Technos chronometer, and pulse oximeter (Dixtal, model DX- 2515).

Procedures

The EPDCT consists of:

1. Initial baseline vital sign assessment - A pulse oximeter was used to assess the heart rate (HR) and saturation of peripheral oxygen (SpO2) every minute for 5 minutes. The average HR and SpO2 were calculated at the end of the 5 minutes. To assess the respiratory rate (RR), we used a manual technique, which consisted of maintaining the examiner's hand on the subject's diaphragm and counting the number of inspirations followed by expirations during the last minute of the assessment of initial baseline vital signs;
2. Swallowing assessment - consisted of the swallowing test, cervical auscultation, and vital signs assessment. The water-swallowing test was performed with the participant sitting on a chair. Two quick taps on the lower face of the subject next to the left cheek were established as the signal to swallowing. The participant was instructed to open her mouth, and 1 mL of filtered water was instilled on the tongue using the disposable 20 mL syringe. The participant was instructed to close her mouth and swallow the contents naturally following the signal. This procedure was

repeated with 3, 5, 10, 15, and 20 mL.

3. The auscultation was performed with an electronic stethoscope positioned on the lateral border of the trachea, inferior to the cricoid cartilage to record the swallowing sound with each offered water volume. To avoid behavioral changes, the participant was not aware of the recording. The analysis of the sounds was performed with the 3M™ Littmann™ Sound Analysis Software, Version 2.0, with the extraction of data from the acoustics and visualization of the color spectrogram. The recorded sounds were classified as follows:

. sound type 1: two audible clicks were identified followed by the expiratory murmur;
. sound type 2: two audible clicks were identified followed by the inspiratory murmur;
. sound type 3: two audible clicks were identified, neither expiration nor inspiration were identified;
. sound type 4: the two swallowing clicks were not identified due to noise interference.

The swallowing response time was recorded through the measure in seconds indicated in the spectrogram and through the use of the cursor. When the swallowing sound was identified, the cursor was interrupted at the exact point where the sound started. The cursor indicated the time marker at which the sound started, with this marker taken as the swallowing response time.

The amount of swallowing was recorded for each offered volume of water for 8 seconds after the command, and either single or multiple swallowing was detected. Multiple swallowing was considered a symptom of dysphagia9,10. The presence of adverse events such as coughing or choking was recorded. The assessment of vital signs during the swallowing test for HR and SpO2 after each swallowing was performed through pulse oximetry.

The protocol interruption criteria were: presence of two consecutive choking events; alterations of SpO2 with a mean decrease of 4% compared to the initial baseline with no recovery within 2 minutes11.

Assessment of the final vital signs baseline was performed through the procedure described in Item 1.

Statistical analysis

The test for comparing two proportions was employed to compare the distribution of the amount of swallowing, type of sound, and adverse events. The test was also applied to analyze the RR and HR in relation to the amount of swallowing. The Mann-Whitney test was applied to compare the two groups regarding quantitative results related to the HR and SpO2 at the initial baseline, during the swallowing test, and at the final baseline. The differences were considered statistically significant when $p < 0.05$. The results were presented as mean ± standard deviation and median, in addition to a confidence interval of 95% for the mean.

In this analysis, we used the software packages: SPSS V11.5, Minitab 14, and Excel XP.

Results

In this study, the SG was composed of 38 elderly, with 27 (71%) men and 11 (29%) Women. The average age was 68 years. The CG consisted of 30 elderly, with 15 (50%) men and 15 (50%) women. The average age was 70 years. There was no significant difference regarding gender or age.

The comparison of the vital signs at the initial and final baseline showed a significant difference between the groups regarding HR, with the highest values in the CG (Table 1). This difference was observed at the initial ($p<0.001$) and at the final ($p<0.001$) baseline. Regarding SpO2, there was no significant difference, i.e., the saturation remained similar before and after the swallowing test in both groups (SpO2 > 96%).

The comparison of the HR in the two groups during the swallowing test also showed that HR was significantly higher in the CG than in the SG ($p<0.003$). Yet, there was no significant difference in SpO2 when comparing the initial baseline with the swallowing test. Regarding the RR, there was no significant difference at the initial and final baseline between the two groups (RR=19 ipm in both groups).

Regarding the number of swallows, single swallowing was predominant in both groups in all measurements except 20 mL (with no significant difference). Therefore, the quantitative swallowing outcomes were not characterized as a symptom of dysphagia.

Regarding swallowing response time, there was a significant difference between the groups when the participants with HR lower than 60 were compared (Table 2). This analysis showed a statistically significant difference for the measures using 3 ml ($p< 0.035$), 10 ml ($p< 0.012$), 15 ml ($p< 0.012$), and 20 ml ($p< 0.033$), with a higher frequency of swallows up to 1 second in the SG. In the participants with HR between 60 and 100 bpm, there was a significant difference at 10 mL, with a higher frequency of swallowing between 1 and 2 seconds in the CG ($p< 0.011$).

Regarding swallowing sound, there was no prevalence of a specific type of sound when

comparing the two groups. A few isolated findings were encountered, such as a higher frequency of Sound Type 1 in the CG with 5 mL and Sound Type 3 with 20 mL also in the GC (p< 0.018).

Regarding adverse events, no significant difference was found in the comparison between the two groups. It is worth highlighting that the frequency of chocking and coughing was very low, i.e., few participants presented these events.

TABLE 1. Comparison of HR at the initial and final baseline and during the swallowing test.

HR	Initial baseline		During the swallowing test		Final baseline	
	GP	GC	GP	GC	GP	GC
Average	62.84	71.91	64.39	73.21	62.94	72.13
Median	61.2	69.8	63.1	70.8	61.9	70.7
Standard deviation	10.82	10.88	10.80	12.13	9.64	10.78
VC	17.2%	15.1%	16.8%	16.6%	15.3%	14.9%
Q1	55.0	63.4	56.1	63.1	55.6	65.0
Q3	65.6	80.4	67.8	81.8	67.4	79.9
N	38	30	38	30	38	30
CI	3.44	3.89	3.44	4.34	3.06	3.86
p-value	<0.001*		0.003*		<0.001*	

VC, variation coefficient; Q, quartile; N, number; CI, confidence interval
* statistical significance (p< 0.05)

TABLE 2. Comparison of swallowing time between the groups with HR lower than 60 during the test.

Volume	Time (seconds)	CG		SG		p-value
		N	%	N	%	
1 ml	0-1	3	10.0%	10	26.3%	0.089
	1-2	0	0.0%	3	7.9%	0.115
	> 2	0	0.0%	1	2.6%	0.371
3 ml	0-1	2	6.7%	10	26.3%	0.035*
	1-2	2	6.7%	3	7.9%	0.847
	> 2	0	0.0%	2	5.3%	0.202
5 ml	0-1	3	10.0%	9	23.7%	0.142
	1-2	1	3.3%	6	15.8%	0.093
	> 2	0	0.0%	0	0.0%	- x -
10 ml	0-1	2	6.7%	12	31.6%	0.012*
	1-2	2	6.7%	3	7.9%	0.847
	>2	0	0.0%	0	0.0%	- x -
15 ml	0-1	2	6.7%	12	31.6%	0.012*
	1-2	2	6.7%	3	7.9%	0.847
	>2	0	0.0%	0	0.0%	- x -
20 ml	0-1	3	10.0%	12	31.6%	0.033*
	1-2	1	3.3%	2	5.3%	0.700
	> 2	0	0.0%	1	2.6%	0.371

N - number of swallows
* statistical significance (p< 0.05)

Discussion

In this study, the analyses showed similarities between the cardiac elderly group and the healthy elderly group regarding oxygen saturation before, during, and after the swallowing test. The HR was lower in the SG before, during, and after the test, which may be related to cardiac disease. HR lower than 60 beats per minute (bpm) occurred in 39% of the cardiac elderly, which seems to have influenced the swallowing time given that such individuals had a decreased swallowing time with almost all water volumes when compared with the CG. The difference between the groups with HR between 60 and 100 bpm was not statistically significant.

Therefore, in the present study, the effect of volume increase over the swallowing response time was not found among the cardiac patients with low HR. This finding may be related to the presence of cardiac disease because it differs from the studies with both normal individuals and healthy elderly individuals, in whom the volume increase was associated with a lower swallowing response time13.

The interpretation of this finding may be supported by studies on the coordination mechanism between respiration and swallowing14,15. As the swallowing occurrence time remained constant in cardiac individuals with decreased HR, it is possible to suggest that these individuals presented swallowing changes to promote a rapid oropharyngeal flow of the offered water volumes. This finding suggests the presence of higher speed for the swallowing start to maintain a short respiratory pause12,13.

Therefore, the coordination characteristics between the swallowing and respiratory functions16 are different in the cardiac elderly than in the healthy elderly. A change in the temporal coordination between these functions appears to be involved, and one of the reasons for this change is the need for a rapid respiratory resumption due to the cardiac disease.

Although the study results point to the presence of modifications in the temporal coordination between swallowing and respiration in the examined groups, it was not possible to determine the respiration phase in which swallowing occurred among the cardiac patients.

Another important finding was the classification of swallowing sounds17-19. The two groups had a similar distribution of sounds types 1, 2, and 3. A few isolated findings were encountered, such as the predominance of Sound Type 1 in the CG with 5 mL and of Sound Type 3 with 20 mL in the same group. This finding may be related to the difficulty in capturing respiratory sounds in both groups.

Conclusion

The decreased swallowing occurrence time in the participants with low HR was the main finding among the cardiac elderly. This finding in isolation may not be an indicator of the presence of OD, but it may be a risk marker for OD. This marker should be further investigated because the lack of coordination between respiration and swallowing may lead to aspiration in the presence of instability or even in increased severity of the cardiac condition. The study contributes to a better understanding of the swallowing process in the cardiac elderly. Further research is necessary to enable a better diagnosis, treatment, and prognosis of oropharyngeal dysphagia in the study group.

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Appendix

Evaluation Protocol of Risk for Dysphagia by Combined Swallowing Test and Vital Signs Monitoring (EPDCT). Dantas, 2008.

Monitoring / Volume	Vital signs		Swallowing recording			
			Auscultation			Adverse event
	SPO2	HR	N. of swallowings	Sound	Response time	Cough and/or chocking
1 ML						
3 ML						
5 ML						
10 ML						
15 ML						
20 ML						

Assessment of the baseline vital signs

Vital signs	Minute 1	Minute 2	Minute 3	Minute 4	Minute 5	Average
Initial SPO_2						
Final SPO_2						
Initial HR						
Final HR						
Initial RR						
Final RR						