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POSTFUNDOPLICATION DYSPHAGIA CAUSES SIMILAR WATER INGESTION DYNAMICS AS ACHALASIA

Roberto Oliveira **DANTAS**, Carla Manfredi **SANTOS**, Rachel Aguiar **CASSIANI**, Leda Maria Tavares **ALVES** and Weslania Viviane **NASCIMENTO**

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ABSTRACT - ***Background -*** After surgical treatment of gastroesophageal reflux disease dysphagia is a symptom in the majority of patients, with decrease in intensity over time. However, some patients may have persistent dysphagia. ***Objective -*** The objective of this investigation was to evaluate the dynamics of water ingestion in patients with postfundoplication dysphagia compared with patients with dysphagia caused by achalasia, idiopathic or consequent to Chagas' disease, and controls. ***Methods -*** Thirty-three patients with postfundoplication dysphagia, assessed more than one year after surgery, together with 50 patients with Chagas' disease, 27 patients with idiopathic achalasia and 88 controls were all evaluated by the water swallow test. They drunk, in triplicate, 50 mL of water without breaks while being precisely timed and the number of swallows counted. Also measured was: (a) inter-swallows interval - the time to complete the task, divided by the number of swallows during the task; (b) swallowing flow - volume drunk divided by the time taken; (c) volume of each swallow - volume drunk divided by the number of swallows. ***Results -*** Patients with postfundoplication dysphagia, Chagas' disease and idiopathic achalasia took longer to ingest all the volume, had an increased number of swallows, an increase in interval between swallows, a decrease in swallowing flow and a decrease in water volume of each swallow compared with the controls. There was no difference between the three groups of patients. There was no correlation between postfundoplication time and the results. ***Conclusion -*** It was concluded that patients with postfundoplication dysphagia have similar water ingestion dynamics as patients with achalasia.

HEADINGS - Deglutition disorders. Gastroesophageal reflux, surgery. Esophageal achalasia. Chagas disease.

INTRODUCTION

Laparoscopic fundoplication is a good option to treat gastroesophageal reflux disease, with the improvement of symptoms in 80%-90% of patients[15,31,32].

In almost all patients, dysphagia is a post-treatment complication that lasts for about 6 weeks and then disappears, while in some, the complication persist beyond 6 weeks[4,31]. Some patients have persistent dysphagia, which may be of significant intensity and compromise the patient's quality of life[17]. Postfundoplication dysphagia is associated with slower bolus transit through the esophageal-gastric junction[12,30,31].

Achalasia is an esophageal motility disorder which has dysphagia and regurgitation as the most frequent symptoms. It is consequent to the impairment or loss of the neurons of the esophageal myenteric plexus, a disease which increases in frequency with age[2,11,24,25]. The motility alterations caused by the damage of the myenteric plexus are partial of absent lower esophageal sphincter (LES) relaxation and absent or simultaneous contractions in the esophageal body[24,25]. The disease may be primary, as idiopathic achalasia[2,24], or secondary as Chagas' disease, a tropical parasitic disease caused by the flagellate protozoan *Trypanosoma cruzi*[19,23]. The esophageal alterations in achalasia cause difficulty in bolus transit through the esophageal-gastric junction[2,23].

Patients with achalasia consequent to Chagas' disease take longer to drink a volume of water, with slower flow of ingestion and a lower volume in each swallow than controls subjects[6]. As fundoplication and achalasia cause slower bolus transit and retention at the esophageal-gastric junction, our hypothesis is that they should have similar water ingestion dynamics. If the hypothesis is true, it is a demonstration of the intensity and importance of postfundoplication dysphagia in patients who have persistent dysphagia.

Our aim in this investigation was to compare the dynamics of water ingestion in three groups of patients,

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Departamento de Clínica Médica da Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo, Ribeirão Preto SP, Brasil.
Correspondence: Roberto Oliveira Dantas. Departamento de Clínica Médica. Faculdade de Medicina de Ribeirão Preto da Universidade de São Paulo - CEP: 14049-900 - Ribeirão Preto, SP, Brasil. E-mail: rodantas@fmrp.usp.br

after fundoplication for treatment of gastroesophageal reflux disease, patients with esophageal involvement by Chagas' disease, patients with idiopathic achalasia, and a control group.

METHODS

The investigation had the participation of 33 patients with postfundoplication dysphagia, 50 patients with Chagas' disease, 27 patients with idiopathic achalasia and 88 controls.

The patients with postfundoplication dysphagia were six (18%) men and 27 (82%) women, aged 25 to 71 years, mean 49.4 (12.3) years. They were operated on 15 months to 62 months (mean: 34.4 months) before the evaluation. They had complain of persistent dysphagia (more than 1 year) for liquid and solid foods, a radiologic examination showing slower bolus transit through the LES, no increase in esophageal diameter, and in esophageal manometry performed with a water infusion system, there was no esophageal motility disorder or absence of LES relaxation. Before the operation, patients did not have dysphagia or esophageal motility abnormalities at manometry.

Patients with Chagas' disease had a positive serologic test for the disease, dysphagia for liquid and solid foods and a radiologic examination showing esophageal retention of barium sulfate inside the esophageal body. For classification of the esophageal involvement in achalasia, the examination was performed with anteroposterior radiograph obtained at a fixed distance (1.8 m) at 10 seconds (s) after the patients swallowed 200 mL of liquid barium sulfate. The result was considered normal if there was no barium in the esophagus, or grade I esophagopathy if there was retention of barium sulfate but the esophageal diameter was less than 4 cm, or grade II if there was esophageal retention and the esophageal diameter was between 4 and 7 cm [20]. Manometric examination was performed with a system of continuously water perfusion, which permitted the diagnosis of esophageal achalasia[8]. The patients were 19 men (38%) and 31 women (62%), aged 29 to 79 years, mean 56.4 (12.4) years. Twenty-six patients were classified as grade I and 24 as grade II in the radiologic examination.

The idiopathic achalasia group included 7 (26%) men and 20 (74%) women, with ages from 23 to 79 years, mean 50.2 (15.8) years. They had dysphagia for liquid and solid foods and in the radiologic examination 14 patients were classified as grade I and 13 patients as grade II. The serologic test for Chagas' disease was negative, as they did not live in places where the disease is endemic. There was no previous treatment for dysphagia in patients with fundoplication, Chagas or idiopathic achalasia.

Upper digestive endoscopy was performed in all patients to rule out some complication of the diseases. They did not have endocrine, neurologic or cardiologic diseases. Patients with Chagas' disease did not have cardiac failure or cardiac arrhythmia[26)].

The control group included 46 (52%) men and 42 (48%) women, ages from 20 to 77 years, mean 46.3 (15.9) years. They did not have dysphagia, regurgitation, heartburn, other digestive symptoms, endocrine, neurologic or cardiologic diseases. They were recruited by advertisement within the hospital. The investigation was approved by the Human Research Committee of the University Hospital. All controls and patients gave written informed consent to participate in the investigation and the anonymity of each volunteer and patient was preserved.

The evaluation of swallowing dynamic was done with the water swallow test[1,3,5,13,29)]. All subjects were evaluated in the sitting position. They were asked to drink without breaks 50 mL of water at room temperature from a plastic cup in a comfortable way while being precisely timed. The chronometer was started when the first drop of water touched the lip, and was stopped when the larynx of the volunteers came to rest after the last swallow. The subjects performed sequential swallows but could stop for breath during each measurement if needed. The swallowing test was performed in triplicate, with an interval between measurements of at least 30 seconds. The final results for each individual were the mean of the three tests. The researchers involved in the project had previous training in timing the swallows and counting the number of swallows, determined from the number of upper movements of the larynx. Also calculated in addition to the time and number of swallows needed to ingest 50 mL of water was: (a) inter-swallows interval - the time to complete the task, in seconds, divided by the number of swallows during the task; (b) swallowing flow - volume drunk (mL) divided by the time taken, in seconds; (c) volume in each swallow - volume drunk (mL) divided by the number of swallows.

The statistical analysis for comparison between groups was done by covariance test (ANCOVA), with Tukey test as a post test for multiple comparisons; adjusted for age and gender, using the software SAS 9.2. The analysis of correlation between the time after surgery and the results of the ingestion was done by the Spearman correlation coefficient (ρ). The results are reported as mean and standard deviation (SD), unless otherwise stated. The differences were considered significant when $P \leq 0.05$ in a two-tailed statistical analysis.

RESULTS

Patients with postfundoplication dysphagia, with Chagas' disease and with achalasia took longer to ingest all the volume of water, had an increased number of swallows to ingest the water volume, an increase in interval between swallows, a decrease in swallowing flow (Figure 1), and a decrease in water volume in each swallow (Figure 2) compared with the control group (Table 1, $P<0.05$). There was no difference between the three groups of patients ($P>0.05$).

Patients with Chagas' disease and patients with idiopathic achalasia had similar results of the test in esophageal radiologic examinations grades I and II ($P>0.30$).

There was no correlation between postfundoplication time and the results of the test. The Spearman correlation coefficient was -0.05 for time of ingestion ($P=0.80$), -0.15 for number of swallows ($P= 0.41$), -0.05 for the inter-swallows interval ($P=0.77$), -0.05 for the swallow flow ($P=0.77$), and -0.15 for the volume in each swallow ($P=0.42$).

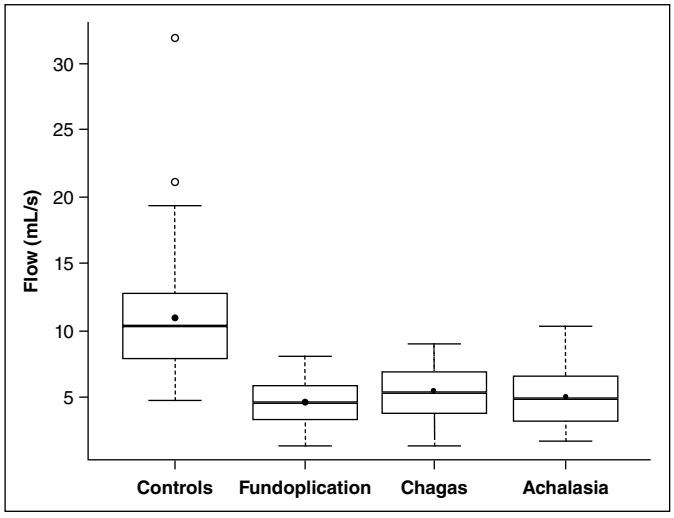

FIGURE 1. Water swallowing flow (mL/s) in controls (n=88), patients with postfundoplication dysphagia (n=33), Chagas' disease (n=50) and achalasia (n=27). $P<0.05$ controls vs fundoplication, Chagas and achalasia.

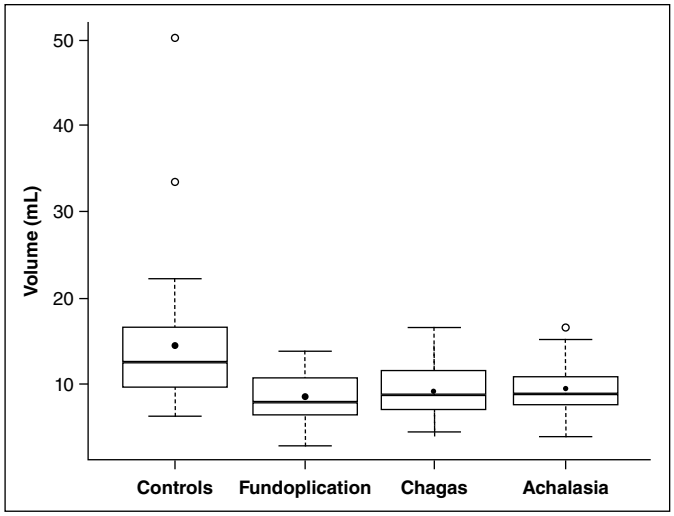

FIGURE 2. Water volume (mL) in each swallow in controls (n=88), patients with postfundoplication dysphagia (n=33), Chagas' disease (n=50) and achalasia (n=27). $P<0.05$ controls vs fundoplication, Chagas and achalasia.

TABLE 1. Ingestion of 50 mL of water in patients with dysphagia postfundoplication (n=33), patients with Chagas' disease (n=50), patients with idiopathic achalasia (n=27) and controls (n=88). Mean (SD).

	Controls	Fundoplication	Chagas	Achalasia
Time (s)	5.4 (2.1)*	13.7 (7.7)	11.4 (5.6)	13.5 (7.7)
Number	4.2 (1.5)*	6.8 (2.8)	6.2 (2.0)	6.0 (2.1)
Interval (s)	1.4 (0.5)*	2.1 (0.6)	1.8 (0.5)	2.1 (0.7)
Flow (mL/s)	11.0 (4.5)*	4.6 (1.8)	5.3 (2.0)	5.2 (2.4)
Volume (mL)	14.5 (8.1)*	8.5 (2.9)	9.0 (2.8)	9.5 (3.0)

* $P<0.05$ vs Fundoplication, Chagas and Achalasia.

DISCUSSION

Idiopathic achalasia is an esophageal motility disorder which has an incidence from 0.1 to 1.6 cases/100000 inhabitants per year[11] which causes impairment of the LES relaxation and aperistalsis in the distal esophagus[25]. Chagas' disease is a cause of secondary achalasia, endemic in Latin America, which affects a large number of subjects[23], but also present in United States[18] and Europe[27]. In both causes of achalasia difficulty in bolus transit through the LES is seen[2,8,20,23,24,25]. High resolution manometry demonstrated that the bolus flow time through the LES is reduced[16], which means that the flow through the esophageal-gastric junction has a short duration, insufficient to permit the flow of all volume swallowed, which is consequent to partial or absent sphincter relaxation. Dysphagia is the most frequent symptom, occurring in 90% of patients[24].

Dysphagia is a symptom which frequently follows the surgical treatment of gastroesophageal reflux disease, which decreases after some weeks. However, it can persist longer than expected and has a negative impact in the outcomes of surgical treatment[31]. Postoperative alterations in the esophageal-gastric junction anatomy should be the most important factor responsible for dysphagia[31].

Preoperative dysphagia (odds ratio: 4.4) and preoperative delayed esophageal transit of barium swallows (odds ratio: 8.2) are risk factors for postoperative dysphagia[30]. Preoperative esophageal dysmotility does not seem to be a cause of persistent dysphagia after operation[4,30]. Others investigations found that before the surgery there is a greater and faster compression of a swallowed viscous bolus, with less bolus flow, in patients who will have postfundoplication dysphagia, suggesting that dysphagia is related to a pre-existing subclinical variation of esophageal function[21,22]. During the bolus transit through the esophageal-gastric junction, there is a relatively high residual relaxation pressure and a high intrabolus pressure measured at distal esophageal body[21,22]. It was also found that impaired esophageal emptying postfundoplication is associated with the inability of distal esophageal muscle to generate necessary tone rapidly[12]. Immobilization of the intrinsic sphincter by the surgical procedure may contribute to this deficiency, impairing the emptying, and possibly causing dysphagia. The absence of previous dysphagia also suggested that the symptom is consequent to fundoplication and not for a previous esophageal alteration not detected in the radiologic, endoscopic and manometric examinations.

In Chagas' disease the patients have a longer pharyngeal transit duration of a paste bolus than normal volunteers[28], have a delay in proximal esophageal response after swallows of a liquid bolus and a decrease in proximal esophageal contractions[6,7]. In idiopathic achalasia it was observed cricopharyngeal prominence and asymmetry of pharyngeal contraction[14], increase in residual pressure in upper esophageal sphincter during opening, a decrease in the opening duration[9] and a decrease in proximal esophageal contraction[10]. These alterations of function may be involved in the impairment of water ingestion. It is possible,

as achalasia, that the pharynx, upper esophageal sphincter and/or proximal esophagus have functional alterations after the fundoplication, possibility not evaluated yet.

There was no association between the time postfundoplication and the results of the water test, suggesting that there is no progression of the water ingestion abnormality, and that the difficult in ingestion is consequent to the surgery and not for a progressive impairment of pharynx and/or esophageal function.

This investigation has some limitations. The water swallow test is not the best way to evaluate the oral, pharyngeal and esophageal functions during swallows. There are other tests to measure transit through the upper digestive tract, as videofluoroscopy, scintigraphy and impedance. However, these tests need sophisticated and more expensive equipment, need expertise and submit the volunteers to radiation or the discomfort of a catheter through the nose. The swallowed volume used in the test might be higher, but in patients with dysphagia for liquid and solid food it is not easy to ingest even the volume of 50 mL. The water swallow test is inexpensive, ease to perform and give a good idea of the dynamic of ingestion. It does not give an idea of the oral, pharyngeal or esophageal phases of the swallow, but a results of all process of swallowing[1,3,5,6,13,29]. The test was able to demonstrate that there is a similar impairment, in terms of difficult for patients to ingest liquid, of water ingestion postfundoplication as seen in achalasia.

In conclusion, water ingestion dynamics in patients with postfundoplication dysphagia is similar to that seen in patients with achalasia, suggesting the possibility of an important esophageal flow impairment through the esophageal-gastric junction.

Authors' contributions

Dantas RO, Santos CM, Cassiani RA, Alves LMT and Nascimento WV: participated in the design of the study, in the collection, analysis and interpretation of the data, in writing the report and in making the decision to submit it for publication.

Dantas RO, Santos CM, Cassiani RA, Alves LMT, Nascimento WV. Disfagia pós-fundoplicatura causa dinâmica de ingestão de água similar a acalasia. Arq Gastroenterol. 2016,53(2): 98-102.

RESUMO - ***Contexto*** **-** Após o tratamento cirúrgico da doença do refluxo gastroesofágico, disfagia é um sintoma presente na maioria dos pacientes, com diminuição de intensidade ao longo do tempo. No entanto, alguns pacientes podem ter disfagia persistente. ***Objetivo*** **-** O objetivo deste trabalho foi avaliar a dinâmica da ingestão de água em pacientes com disfagia persistente após tratamento cirúrgico da doença do refluxo gastroesofágico comparando-os com os pacientes com disfagia causada por acalásia, idiopática ou consequente à doença de Chagas, e controles. ***Métodos*** **-** Trinta e três pacientes com disfagia pós fundoplicatura, que persiste a mais de um ano após a cirurgia, em conjunto com 50 pacientes com doença de Chagas, 27 pacientes com acalásia idiopática, todos com disfagia, e 88 controles foram avaliados pelo teste de ingestão de água. Eles ingeriram, em triplicata e sem pausas, 50 mL de água, o tempo de ingestão foi precisamente cronometrado e contado o número de deglutições necessário para ingerir todo volume. Com estes resultados foram calculados: (a) intervalo entre deglutições - tempo para completar a ingestão dividido pelo número de deglutições; (b) fluxo de ingestão - volume ingerido dividido pelo tempo necessário; (c) volume em cada deglutição - volume ingerido dividido pelo número de deglutições. ***Resultados*** **-** Os pacientes com disfagia pós fundoplicatura, doença de Chagas e acalásia idiopática levaram mais tempo para ingerir todo volume, tiveram maior número de deglutições, maior intervalo entre as deglutições, diminuição do fluxo de ingestão e diminuição no volume de água de cada deglutição em comparação com os controles. Não houve diferença entre os três grupos de pacientes. Não houve correlação entre o tempo após a operação e os resultados. ***Conclusão*** **-** Os pacientes com disfagia pós fundoplicatura tem dinâmica de ingestão de água semelhante aos pacientes com acalasia.

DESCRITORES - Transtornos de deglutição. Refluxo gastroesofágico, cirurgia. Acalasia esofágica. Doença de Chagas.

REFERENCES

1. Alves LMT, Cassiani RA, Santos CM, Dantas RO. Gender effect on the clinical measurement of swallowing. Arq Gastroenterol. 2007;44:227-9.
2. Ates F, Vaezi MF. The pathogenesis and management of achalasia: current status and future directions. Gut Liver. 2015;9:449-63.
3. Belo LR, Gomes NAC, Coriolano MGWS, Souza ES, Moura DAA, Asano AG, et al. The relationship between limit of dysphagia and average volume per swallow in patients with Parkinson' disease. Dysphagia. 2014;29:419-24.
4. Broeders JA, Sportel IG, Jamieson GG, Nijar RS, Granchi N, Myers JC, et al. Impact of ineffective oesophageal motility and wrap type on dysphagia after laparoscopic fundoplication. Br J Surg. 2011;98:1414-21.
5. Chee C, Arshad S, Singh S, Mistry S, Hamdy S. The influence of chemical gustatory stimuli on oral anaesthesia on healthy human pharyngeal swallowing. Chem Senses. 2005;30:393-400.
6. Dantas RO, Alves LMT, Cassiani RA, Santos CM. Clinical measurement of swallowing and proximal esophageal contractions in Chagas' disease. Esophagus. 2009;6:231-6.
7. Dantas RO, Alves LMT, Nascimento WV. Effect of bolus volume on proximal esophageal contractions of patients with Chagas' disease and patients with idiopathic achalasia. Dis Esophagus. 2010;23:670-4.
8. Dantas RO, Deghaide NHS, Donadi EA. Esophageal motility of patients with Chagas' disese and idiopathic achalasia. Dig Dis Sci. 2001;46:1200-6.
9. Dudnick RS, Castell JA, Castell DO. Abnormal upper esophageal sphincter function in achalasia. Am J Gastroenterol. 1992;87:1712-5.
10. Dunaway PM, Maydonovitch CL, Wong RKW. Characterization of esophageal striated muscle in patients with achalasia Dig Dis Sci. 2000;45:285-8.
11. Farrukh A, Mayberry JF. Achalasia: an epidemiologic update. Esophagus. 2015;12:170-4.
12. Gosh SK, Kahrilas PT, Zaki T, Pandolfino JE, Joehl RJ, Brasseur JG. The mechanical basis of impaired esophageal emptying postfundoplication. Am J Physiol. 2005,289:G21-35.
13. Hughes TA, Wiles CM. Clinical measurement of swallowing in healthy and neurogenic dysphagia. Q J Med. 1996;89:109-16.
14. Jones B, Donner MW, Rubesin SE, Ravich WJ, Hendrix TR. Pharyngeal findings in 21 patients with achalasia of the esophagus. Dysphagia. 1987;2:87-92.
15. Le Blanc-Louvry I, Koning E, Zalar A, Touchais O, Savoye Collet C, Denis P, et al. Severe dysphagia after laparoscopic fundoplication: usefulness of barium meal examination to identify causes other than tight fundoplication - a prospective study. Surgery. 2000;128:392-8.
16. Lin Z, Carlson DA, Dykstra K, Sternbach J, Hungness E, Kahrilas PJ, et al. High-resolution impedance manometry measurement of bolus flow time in achalasia and its correlation with dysphagia. Neurogastroenterol Motil. 2015;27:1232-8.
17. Lundell L, Attwod S, Ell C, Fiocca R, Galmiche JP, Hatlebakk J, et al. Comparing laparoscopic antireflux surgery with esomeprazole in the chronic gastro-esophageal reflux disease: a 3-year interim analysis of the LOTUS trial. Gut. 2008; 57:1207-13.
18. Manne-Goehler J, Reich MR, Wirtz VJ. Acess of care for Chagas' disease in the United States: a health system analysis. Am J Trop Med Hyg. 2015;93:108-13.
19. Matsuda NM, Miller SM, Évora PRB. The chronic gastrointestinal manifestations of Chagas' disease. Clinics. 2009; 64:1219-24.
20. Meneghelli UG, Peria FM, Darezzo FMR, Almeida FH, Rodrigues CM, Aprile LRO, et al. Clinical, radiographic, and manometric evolution of esophageal involvement by Chagas' disease. Dysphagia. 2005;20:40-5.
21. Myers JC, Jamieson GG, Sullivan T, Dent J. Dysphagia and gastroesophageal junction resistance to flow following partial and total fundoplication. J Gastrointest Surg. 2012;16:475-85.
22. Myers JC, Nguyen NQ, Jamieson GG, Van'T Hek JE, Ching K, Holloway RH, et al. Suceptibility to dysphagia after fundoplication revealed by novel automated impedance manometry analysis. Neurogastroenterol Motil. 2012; 24:812-e393.
23. Oliveira RB, Troncon LEA, Dantas RO, Meneghelli UG. Gastrointestinal manifestations of Chagas' disease. Am J Gastroenterol. 1998;93:884-9.
24. Pandolfino JE, Gawron AJ. Achalasia: a systematic review. JAMA. 2015;313:1841-52.
25. Pandolfino JE, Kahrilas PJ. Presentation, diagnosis and management of achalasia. Clin Gastroenterol Hepatol. 2013;11:887-97.
26. Rassi A Jr, Rassi A, Marin-Neto JA. Chagas' disease. Lancet. 2010;375:1388-402.
27. Requena-Mendez A, Aldasoro E, de Lazzari E, Sicuri E, Brown M, Moore DA, et al. Prevalence of Chagas' disease in Latin-American migrants living in Europe: a systematic review and meta-analysis. PLoS Negl Trop Dis. 2015;9:e000354.
28. Santos CM, Cassiani RA, Dantas RO. Videofluoroscopic evaluation of swallowing in Chagas' disease. Dysphagia. 2011;26:361-5.
29. Teismann IK, Steinstraeter O, Stoeckight K, Sontrup S, Wollbrink A, Pantev C, et al. Functional oropharyngeal sensory disruption interferes with the cortical control of swallowing. BMC Neuroscience. 2007;8:62-69.
30. Tsuboi K, Lee TH, Legner A, Yano F, Dworak T Mittal SK. Identification of risk factors for postoperative dysphagia after primary anti reflux surgery. Surg Endosc. 2011;25:923-9.
31. Wilshire CL, Niebisch S, Watson TJ, Litle VR, Peyre CG, Jones CE, et al. Dysphagia postfundoplication: more commonly hiatal outflow resistance than poor esophageal body motility. Surgery. 2012;152:584-94.
32. Zaninotto G, Portale G, Constantini M, Rizzeto C, Guirroli E, Ceolin M, et al. Long-term (6-10 years) of laparoscopic fundoplication. J Gastrointest Surgery. 2007;11:1138-45.