

Diaphragmatic Rehabilitation Therapy for the Management of Supragastric Belching: Case Series and Literature Review

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Abstract

Belching is a physiological event that allows air to be released from the esophagus or stomach to the pharynx. It can become excessive, bothersome, and difficult to control in some patients, making it a common reason for consultation with a gastroenterologist. This paper aims to present a series of cases from our experience at a gastrointestinal motility reference center in managing patients with supra gastric belching using diaphragmatic rehabilitation therapy and to conduct a literature review.

Keywords

Belching, Esophageal pH Monitoring, Diagnosis, Treatment.

INTRODUCTION

Belching is the audible release of air from the esophagus or stomach into the pharynx⁽¹⁾. It is a physiological event that typically occurs up to 30 times a day⁽²⁾. Although common in the general population, it can be considered a disorder when it becomes excessive and bothersome⁽¹⁾. Patients who are unable to control their belching in public may feel embarrassed, disrupting their social life and negatively impacting their quality of life^(2,3). These are the patients who most often seek medical consultation for their symptoms⁽³⁾.

Studies report the prevalence of belching symptoms in the general population, with rates ranging between 6.7% and 28.8%⁽³⁾. One study found that approximately 3.4% of patients with upper gastrointestinal discomfort referred to a gastrointestinal physiology unit had supragastric belching (SB)⁽⁴⁾. However, the results can vary depending on the definition of excessive belching⁽³⁾.

Belching can occur in isolation or be associated with other gastrointestinal complaints such as gastroesophageal reflux disease (GERD), rumination syndrome, or functional dyspepsia⁽²⁾. It has also been linked to psychological disorders such as anxiety and depression. The advent of technologies

and advances in impedance monitoring and high-resolution esophageal manometry have improved our understanding of belching⁽⁵⁾. The aim of this study is to present a case series from our experience at a gastrointestinal physiology referral center in managing patients with SB using diaphragm rehabilitation, alongside a review of the literature.

MATERIALS AND METHODS

Consecutive patients referred to the gastrointestinal motility laboratory at the GutMédica Institute in Bogotá, Colombia, from January to December 2021, aged 18 years or older, were included in this study. These patients underwent 24-hour esophageal pH-impedance monitoring (pH-IIM) without proton pump inhibitors (PPIs) due to frequent belching as their predominant symptom, whether or not it was associated with typical GERD symptoms. Patients who were taking PPIs or had a history of esophageal or gastric surgery were excluded. Prior to the test, typical symptoms (heartburn and regurgitation) and atypical symptoms (belching, dysphagia, cough, throat clearing, and globus sensation) were assessed using a standardized questionnaire. Patients presented for the exam after fasting for at least eight hours.

The lower esophageal sphincter (LES) was located manometrically, and a catheter with impedance sensors at 3, 5, 7, 15, and 17 cm, and a pH sensor 5 cm above the upper edge of the LES, was used. Monitoring lasted at least 20 hours, and patients were given a diary to record symptoms during the study period. They were instructed to maintain their daily activities, meal schedules, and normal sleep patterns.

Data from the impedance and pH channels were stored on portable equipment by Sandhill Scientific or Sierra. The traces were reviewed, and manual editing was performed by expert gastroenterologists who noted meal events and symptom recordings. Meal periods were excluded from the analysis. A supragastric belching (SB) event was defined by an increase in impedance moving in a caudal direction from the proximal to the distal channel, followed by a return to baseline, starting in a retrograde manner from the distal channel.

Patients with frequent SB underwent diaphragm biofeedback therapy, with a protocol of one to two sessions per week, each lasting 45 minutes. The sessions were individualized, focusing on the specific needs of each patient, and were conducted by the same clinician. The treatment included an assessment to identify the patterns triggering the belching. Next, patients were educated about the nature of their symptoms to promote awareness and understanding of the factors causing them. During the therapy, techniques were applied such as postural correction, manual therapy for diaphragm release aimed at restoring proper mobility

during breathing phases, and respiratory pattern awareness with an emphasis on diaphragmatic breathing. This included phonorespiratory coordination, myofunctional exercises for phonoarticular muscles, glottis training, vocal orientation and training exercises, and swallowing exercises designed to limit air entry into the esophagus. All exercises were focused on controlling the air entry and exit from the esophagus during daily activities.

A symptom evaluation was performed before and after the therapy sessions via a telephone survey, using the Visual Analog Scale (VAS) with scores ranging from 0 to 10 (0-3: mild, 4-6: moderate, 7-10: severe). A significant response was defined as a VAS improvement from severe to mild, while a partial response was considered when the change was from severe to moderate or from moderate to mild.

CASE PRESENTATION

Fifteen patients (8 women), aged between 21 and 70 years, are presented. In 33% of the patients, reflux hypersensitivity was evident, while 66% did not have pathological acid reflux. On average, seven (range: 3-20) diaphragm biofeedback therapy sessions were conducted. A significant response was observed in 66% of the patients, with better outcomes reported as the number of therapy sessions increased. The characteristics of the patients are shown in **Table 1**.

Eighty-six percent of patients showed improvement in the symptom of excessive belching (**Figure 1**); 73% reported improvement in their family environment (**Figure 2**); 66% reported improvement in their work environment (**Figure 3**); 74% experienced improvement in their social environment (**Figure 4**); and 94% achieved self-control over their belching.

PHYSIOLOGY OF BELCHING

With each swallow, a variable volume of air is ingested and transported to the stomach⁽⁵⁾. During belching, the accumulated intragastric air is vented into the esophagus, after which it may be expelled through the mouth⁽⁵⁾. The motor events of belching consist of three independent phases that are coordinated with each other: the gastric gas escape phase, the upper barrier elimination phase, and the gas transport phase⁽⁶⁾. The gastric gas escape phase involves a gastro-LES inhibitory reflex, causing transient relaxations of the lower esophageal sphincter (LES), which is triggered by distention of stretch receptors in the proximal stomach⁽⁶⁾. The upper barrier elimination phase involves transient relaxation of the upper esophageal sphincter (UES) along with airway protection, activated by stimulation of rapidly adapting mechanoreceptors in the esophageal mucosa⁽⁶⁾. The gas transport phase is reverse esophageal peristalsis, mediated by elementary

Table 1. Characteristics of Patients with Supragastric Belching

Age	Sex	Esophageal pH-Impedance	AET	Number of Belches	Number of Therapy Sessions	Significant Response
51	M	Negative for pathological acid reflux	0.2%	10	7	Yes
60	F	Negative for pathological acid reflux	0.2%	33	9	Yes
32	M	Negative for pathological acid reflux	0.1%	17	3	No
32	M	Negative for pathological acid reflux	0.5%	27	5	Yes
60	M	Negative for pathological acid reflux	1.3%	38	7	Yes
26	M	Reflux hypersensitivity	1.1%	56	3	No
30	F	Reflux hypersensitivity	1.9%	16	3	No
21	F	Reflux hypersensitivity	0.5%	36	9	Yes
52	F	Negative for pathological acid reflux	0.1%	16	3	No
27	F	Negative for pathological acid reflux	0.1%	18	7	Yes
61	F	Negative for pathological acid reflux	0.1%	10	3	No
70	M	Negative for pathological acid reflux	0.4%	24	10	Yes
49	M	Negative for pathological acid reflux	0.3%	211	20	Yes
22	F	Reflux hypersensitivity	1.3%	27	5	Yes
31	F	Reflux hypersensitivity	0.1%	26	10	Yes

Author's own research.

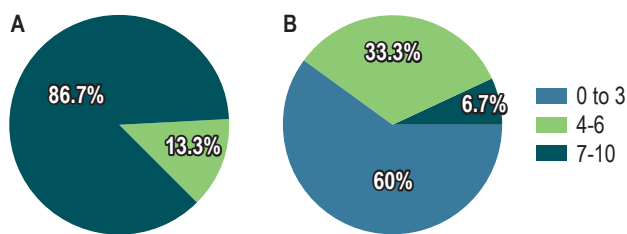


Figure 1. Symptom Discomfort. **A.** Discomfort before therapy. **B.** Discomfort after therapy. Author's own research.

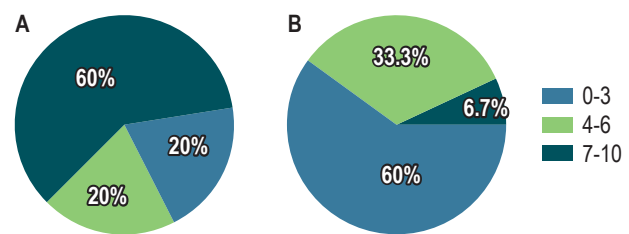


Figure 2. Discomfort in the Family Environment. **A.** Discomfort in the family environment before therapy. **B.** Discomfort in the family environment after therapy. Author's own research.

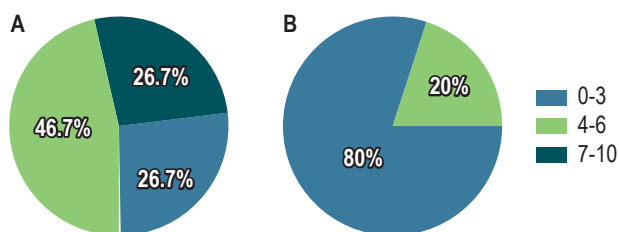


Figure 3. Work Environment Interference. **A.** Interference in the work environment before therapy. **B.** Interference in the work environment after therapy. Author's own research.

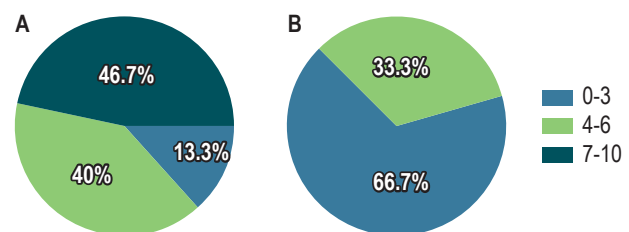


Figure 4. Interference in Social Activities. **A.** Interference in social activities before therapy. **B.** Interference in social activities after therapy. Author's own research.

reflexes, and is believed to be triggered by rapidly adapting tension receptors in the serosa⁽⁶⁾.

CLASSIFICATION AND PATHOPHYSIOLOGY

There are two different types of belching: supragastric belching (SB) and gastric belching (GB). SB is considered an unintentional response to an uncomfortable sensation in the abdomen or retrosternal region, which does not occur during sleep, speech, or moments when the patient is distracted. Over time, SB can become a learned behavior for the patient⁽²⁾.

In supragastric belching, air rapidly enters the esophagus, followed immediately by its quick expulsion. Two theories explain its mechanism:

- Air suction method: There is a movement of the diaphragm (in a proximal direction) that increases negative intrathoracic pressure, similar to what occurs during a deep inspiration. During SB, the upper esophageal sphincter (UES) relaxes, the glottis closes, and air flows from atmospheric pressure in the pharynx to subatmospheric pressure in the esophagus. This esophageal air is then expelled orally, with the patient perceiving it as a belch⁽⁶⁻⁸⁾.
- Air injection method: There is a simultaneous increase in pressure in the pharynx that initiates air entry into the esophagus. The pressure gradient is caused by elevated pharyngeal pressure, without any change in intraesophageal pressure. This can be due to increased pressure or contractions at the base of the tongue, and esophageal peristalsis does not occur (no simultaneous contraction of the esophagus)^(7,8).

GB is considered a physiological mechanism and occurs due to the rapid release of air from the stomach secondary to transient relaxation of the lower esophageal sphincter (LES). This mechanism prevents excessive abdominal distention from swallowed air⁽²⁾.

DIAGNOSIS

The diagnosis is made through clinical evaluation and a thorough history taking. This helps to rule out the presence of red flags that may suggest organic causes, such as dysphagia or weight loss, and to assess the frequency and clinical pattern of the belching. Conditions such as GERD or anatomical abnormalities that may be involved must be ruled out^(4,5). In some cases, invasive investigations are unnecessary, as during the consultation, the patient may present with frequent and repetitive belching, suggestive of supragastric belching (SB). Gastric belching (GB) is neither rapid nor repetitive^(1,8).

According to the Rome IV criteria, belching disorders are classified into two types: excessive SB and excessive GB (Table 2)⁽¹⁾. The term aerophagia (frequent air swallowing), previously considered a mechanism of belching disorder under the Rome III criteria, was removed in the latest version of Rome IV because not all cases result from air swallowing⁽¹⁾.

Table 2. Diagnostic Criteria for Belching Disorders According to Rome IV Criteria

Belching Disorders
Diagnostic Criteria ^a
Must include all of the following:
- Belching from the esophagus or stomach occurring more than three days a week (severe enough to impact usual activities) Excessive supragastric belching (from the esophagus) Excessive gastric belching (from the stomach)
Supporting Comments
- Supragastric belching is supported by the observation of frequent and repetitive belching.
- Gastric belching has no established clinical correlation.
- Objective intraluminal impedance measurement can be used to distinguish supragastric belching from gastric belching.

^aCriteria present for the previous three months with symptom onset at least six months before diagnosis. Adapted from: Stanghellini V, and colleagues. Gastrointestinal Disorders. Gastroenterology. 2016;150(6):1380-1392⁽¹⁾.

The gold standard for diagnosis and classification is 24-hour impedance-pH monitoring, which allows differentiation between the two types of belching and distinguishes them from GERD⁽⁹⁾. The esophageal impedance catheter is based on Ohm's law, which states that impedance to current flow is inversely related to the medium's electrical conductivity. As a result, this device can detect liquid or air refluxed into the esophagus based on changes in electrical conductivity, regardless of whether the content is acidic or non-acidic⁽⁹⁾. The transit of intraesophageal content can be detected through sequential changes in impedance along the catheter. Impedance monitoring plays a key role in the study of belching, as the conductivity of air is very low, and the presence of air between the electrodes results in an increase in impedance. Additionally, the direction of air flow must be evaluated. In GB, an impedance increase begins in the distal channel and progresses toward the more proximal channel, while in SB, the impedance increase begins in the proximal channel and progresses toward the distal channel (Figures 5 and 6)⁽⁷⁻¹⁰⁾.

TREATMENT

The most important aspect is establishing a strong doctor-patient relationship, in which the mechanism behind the belching is clearly explained during the consultation. In most cases, patients expect an explanation of their condition and hope to find an organic cause; however, in the absence of an organic etiology, some patients may disagree with the information provided^(4,5).

Currently, behavioral therapy and speech therapy are considered the most effective treatments for this condition⁽¹¹⁻¹⁷⁾. Proper diagnosis with pH-impedance monitoring helps confirm that a behavioral disorder is present, which gives patients a clearer understanding of their symptoms and facilitates behavior modification and deconditioning^(7,10). The mechanism of air suction or injection into the esophagus should be explained to the patient to prevent its repetition and to achieve smooth breathing patterns. This is accomplished through exercises that train the glottis, vocal cords, and breathing⁽¹⁰⁾. Since SB is a learned behavior, behavioral therapy is useful. A recent clinical trial involving 42 patients with SB found that behavioral therapy reduced the frequency and intensity of belching at six months, with a 75% response rate to the therapy⁽¹³⁾. Cognitive-behavioral therapy has positive effects that persist for at least six to twelve months after treatment⁽¹⁴⁾.

Additionally, speech therapy and biofeedback can help reduce excessive belching⁽¹⁵⁾. Abdominal breathing exercises can be taught by having the patient place a hand on their

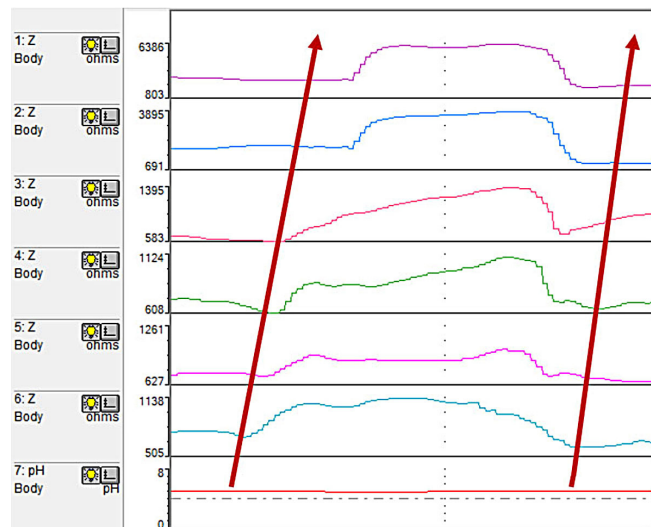


Figure 5. Gastric belching: Increase in impedance begins in the most distal channel and progresses toward the most proximal channel. Air is expelled from the esophagus in the oral direction, and impedance returns to baseline from the distal to the proximal channel (the arrows indicate the direction of airflow). Adapted from: Kessing BF, and colleagues. *Am J Gastroenterol.* 2014;109(8):1196-203⁽⁷⁾.

abdomen during breathing, ensuring that the hand moves throughout the respiratory cycle. This shifts attention from the belching to the behavior associated with it, fostering a cognitive process that is crucial for successful therapy. It is believed that 10 to 20 sessions are needed to achieve a

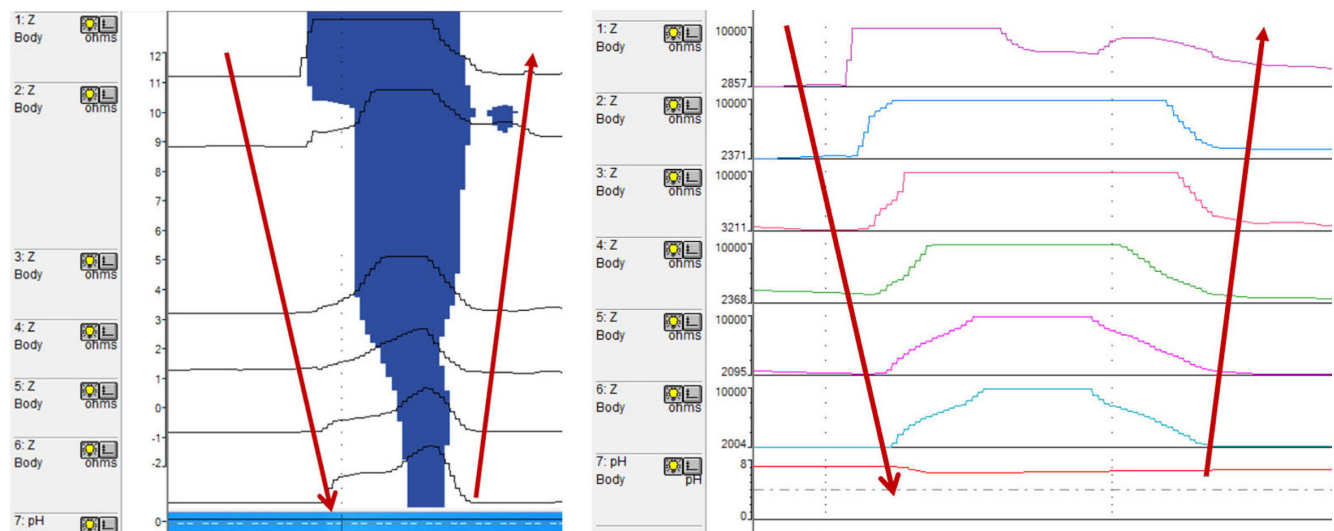


Figure 6. Supragastric belching: Increase in impedance begins in the proximal channel and progresses toward the distal channel. Air is expelled from the esophagus in the oral direction, and impedance returns to baseline starting from the distal and ending at the proximal channel (the arrows indicate the direction of airflow). Adapted from: Kessing BF, and colleagues. *Am J Gastroenterol.* 2014;109(8):1196-203⁽⁷⁾.

significant reduction in belching complaints, although this is not yet standardized^(7,8). Conducting therapy guided by impedance monitoring may facilitate the correlation of symptoms with real-time visual information, helping to improve patient understanding and motivation. However, the catheter can be uncomfortable and might reduce adherence to therapy⁽¹⁰⁾.

It is important to practice daily exercises that include breath-holding through glottic tension, with both laryngeal and oral closure, while redirecting the patient's attention away from the belching toward the actions that precede it. The patient can observe themselves in a mirror, or in some cases, videos can be used to document the events⁽¹⁰⁾. Exercises should be performed to improve abdominal breathing, ensuring that it is smooth and calm, avoiding sudden stops. These exercises should be practiced both at rest and while speaking. Additionally, in cases of severe, persistent belching, the technique of breathing with a finger between the teeth can be used, along with phonation exercises to reduce subglottic pressure and tension in the laryngeal muscles, and appropriate diaphragmatic breathing. The laryngeal-cricopharyngeal-lingual complex is also studied to unlearn ineffective actions like movements of the tongue, larynx, and upper esophagus, through jaw relaxation exercises, laryngeal manipulation, effective articulation, and vocal techniques. If suboptimal swallowing is present, activities are performed to improve oral preparation, optimize the transport phase, and coordinate swallowing with breathing^(10,15).

Another behavioral therapy method involves teaching the patient to breathe with the mouth open and the tongue positioned behind the upper incisors, combined with slow, conscious diaphragmatic breathing in 3-second inhalation and exhalation cycles. These exercises should be practiced at least twice daily for three to four minutes in both the supine and upright positions. After this initial process, the exercises should be performed daily and as frequently as possible to prevent belching by recognizing warning signs of when belching might occur. The response to these therapies is subjectively recorded using visual analog scales (VAS) and quality-of-life questionnaires, which have shown improvements in perceived belching severity and quality of life in more than 50% of published studies⁽¹¹⁾. Sustained glottic

opening can improve by up to 75% at three months, and the therapy can be performed in the office^(10,16). This therapy involves slow, diaphragmatic breathing with the mouth open, starting in the supine position and then sitting to prevent belching. If successful, the patient is advised to repeat this sequence at home⁽¹⁶⁾. Finally, hypnotherapy has been used anecdotally with good results⁽¹⁸⁾.

The only pharmacological treatment that has shown efficacy is baclofen, sometimes in combination with pregabalin. By reducing transient lower esophageal sphincter relaxations, it also decreases reflux events and may influence the mechano- and chemosensitivity of the esophagogastric junction. However, these medications can cause excessive drowsiness, and due to their side effects, they are infrequently used^(19,20).

CONCLUSION

Belching is a physiological event; however, for some patients, it can become a medical issue due to its excessive or difficult-to-control occurrence. Belching may occur in isolation or be associated with other gastrointestinal disorders such as GERD, rumination syndrome, or functional dyspepsia. Impedance monitoring assists in the accurate classification of belching. The most important aspect is a strong doctor-patient relationship, where the mechanism behind the belching is clearly explained to the patient. Psychoeducation is a therapeutic option since SB is a learned behavior. For the treatment of SB, diaphragmatic biofeedback therapy is an effective strategy. Other available alternatives include behavioral and speech therapy.

Conflict of Interest

No conflicts of interest were declared.

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