PERSPECTIVES IN CLINICAL GASTROENTEROLOGY AND HEPATOLOGY

Management of Belching, Hiccups, and Aerophagia

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Although belching and hiccups are regarded as normal behaviors, they can occur at high frequency or become persistent, becoming bothersome and requiring medical care. Patients with excessive belching frequently have supragastric belches. Excessive belching should be treated as a behavioral disorder. Persistent hiccups, however, can be the first presentation of a serious disorder that requires extensive diagnostic testing. When no cause is found, only the symptoms can be treated. Aerophagia is an episodic or chronic disorder in which patients (children and adults) swallow large quantities of air, which accumulate in the gastrointestinal tract to cause abdominal distention and bloating. These patients should not undergo explorative laparotomy because they do not have ileus. New treatment approaches are needed for patients with aerophagia.

Keywords: Stomach; Esophagus; Transient Lower Esophageal Sphincter Relaxation; Chlorpromazine; Baclofen.

Belching and hiccups occur occasionally in everyone and most often are not related to a disease or pathologic condition. Only rarely a physician is consulted for these complaints. Only when belching and hiccups become very frequent and bothersome is it considered pathologic. Aerophagia and excessive belching are 2 different conditions that often are mistaken for each other. Aerophagia is a disorder in which the voluminous intake of air results in abdominal distention and bloating, in contrast to excessive belching disorder in which belching is the predominant symptom.

In this review the available knowledge on the management of belching, hiccups, and aerophagia is discussed.

Belching

Gastric and Supragastric Belching

Belching is the audible escape of air from the esophagus into the pharynx. The medical term for belching is *eructation*. We distinguish 2 types of belches: the so-called *gastric belch* and *supragastric belch*.[1] Gastric belching is the escape of swallowed intragastric air that enters the esophagus during a transient lower-esophageal sphincter relaxation (TLESR).[2] TLESRs are triggered by distention of the proximal stomach and allow venting of air from the stomach, thereby serving as a gastric decompression mechanism and preventing passage of large volumes of gas through the pylorus into the intestines. TLESRs therefore sometimes are referred to as the belch reflex.[3,4] Once in the esophagus, esophageal distention caused by the refluxed air initiates reflexogenic relaxation of the upper-esophageal sphincter (UES) through which the air can escape the esophagus.[5,6] Gastric belches occur 25 to 30 times per day and are physiological. Gastric belches are involuntary and are controlled entirely by reflexes.[7]

In supragastric belches the air does not originate from the stomach but is ingested immediately before it is expelled again. Supragastric belches are not a reflex but instead are the result of human behavior. Studies with simultaneous impedance monitoring and high-resolution manometry reveal the underlying mechanism of this behavior.[1,8] A contraction of the diaphragm creates a negative pressure in the thoracic cavity and the esophagus, subsequent relaxation of the UES, resulting in inflow of air into the esophagus (Figure 1). The air thus is suctioned into the esophagus where it is expelled again immediately in a pharyngeal direction using straining. A minority of subjects that express supragastric belching use a different technique. They inject air into the esophagus by a simultaneous contraction of the muscles of the base of the tongue and the pharynx. The subsequent expulsion of air out of the esophagus in retrograde direction is induced by straining and goes through a similar mechanism as in patients who apply suction to move the air into the esophagus.

Many insights gained into belching physiology and pathophysiology over the past 10 years are the results of studies with esophageal electrical impedance monitoring. With impedance monitoring the resistance of a medium to an alternating electrical current is measured and this allows one to measure movement of air in the esophagus. It is thus a very useful tool in the evaluation of belching and air swallowing.

Excessive Supragastric Belching

Some patients consult with isolated excessive belching and report that they suffer from episodes of frequent belching in which they may belch up to 20 times a minute. These patients may show spells of excessive belching during consultation with their physician. Patients who complain of isolated

Abbreviations used in this paper: GERD, gastroesophageal reflux disease; TLESR, transient lower esophageal sphincter relaxation; UES, upper-esophageal sphincter.

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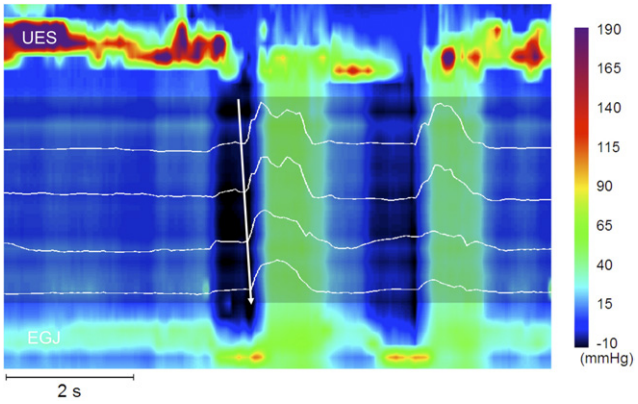

Figure 1. Combined high-resolution manometry and impedance monitoring showing a supragastric belch. Because of a contraction of the diaphragm, the esophagogastric junction (EGJ) moves distally and a decrease in pressure in the esophagus is observed. Subsequently, relaxation of the UES allows the influx of air from the pharynx into the esophagus seen on the impedance tracing (*arrow*). The supragastric belch is characterized by an increase in impedance, starting in the proximal impedance channel, and progressing to the most distal impedance channel and followed by a return to baseline, starting in the most distal channel and progressing to the proximal channel. The movement of air out of the esophagus in a retrograde direction is caused by straining, as can be seen as a simultaneous increase in pressure in esophageal and gastric channels.

excessive belching almost without exception suffer from excessive uncontrolled supragastric belching. A high prevalence of anxiety disorders has been described in these patients and some patients report that their symptoms increase during stressful events.[9] Excessive belching also has been described in patients with obsessive compulsive disorder, bulimia nervosa, and encephalitis.[10–12] Many patients stop belching during speaking and it has been shown that distraction also reduces the frequency of belching whereas putting attention to their belching behavior usually results in an increase in belching frequency.[13] Supragastric belching is never observed during sleep.[14] Careful history taking is usually enough to establish a diagnosis but sometimes an impedance monitoring test may be required; this can help to distinguish excessive supragastric belching from gastroesophageal reflux disease (GERD) and rumination.[15] The diagnosis is made when spells of supragastric belches are observed during the impedance measurement (Table 1). Patients with excessive supragastric belching usually have no other symptoms besides sometimes some dyspeptic symptoms. The presence of weight loss, pain, dysphagia, heartburn, and regurgitation are not compatible with excessive supragastric belching and are an indication for further diagnostic evaluation.

It is unclear what causes supragastric belching and what causes patients to start this behavior. Some patients report that initially they belched purposefully to relieve a sensation of bloating or abdominal discomfort but that with time they lost control of the belching.

It is important to realize that supragastric belching is not the same as air swallowing or aerophagia (Greek for "air eating"). With every swallow a certain volume of air is ingested and this is transported by the peristaltic contraction wave to the stomach; this is what we call *air swallowing*.[7,16] During supragastric belching peristaltic contractions in the esophagus are not seen, the air is injected by pharyngeal muscle contraction or through suction created by a negative intrathoracic pressure. Aerophagia is a disorder in which there is a true increase in ingested volume of air as a result of air swallowing, and thus this is distinct from excessive supragastric belching.[17]

Management of Supragastric Belching

Patients with excessive belching often complain of social isolation as a result of the excessive belching and it is important to take their symptoms seriously because these patients often suffer from a decreased health-related quality of life.[18] Little evidence exists on the optimal treatment of patients with supragastric belching. In our institution we always start with explaining the mechanism of belching to the patient; this can be difficult because some patients are convinced of the presence of a gas-producing mechanism in the stomach or intestines and find it difficult to accept that it is a behavior disorder that is causing the excessive belching. Some physicians show the patient that they are able to belch intentionally themselves, to convince the patient that this is learned behavior. When there is a suspicion that excessive belching is secondary to a psychiatric disorder, the patient is referred for an evaluation by a psychiatrist first.

The only evidence for treatment of supragastric belching is provided by an open-label study by Hemmink et al.[19] In that study 11 patients with excessive supragastric belching were referred to a speech therapist with experience in treatment of these patients. It is important to mention that this therapist was well informed of the mechanisms of supragastric belching. The therapy focused on explanation and on creating awareness of the belching mechanism. The first step consisted of a description of the behavior that caused the injection or suctioning of air and was accompanied by glottis training and conventional breathing and vocal exercises. Early in the therapy, attention on belching was moved to attention on the periods of tight glottal and mouth closure. Symptom intensity and frequency, as scored with a visual analogue scale, improved significantly after 10 treatment sessions. Only 1 patient showed no response and stopped treatment early. It can be argued that this was an open-label study and that its results were a reflection of the natural cause of the symptoms, but the patients had a mean symptom duration of 2.1 years at presentation, which makes a spontaneous symptom regression less likely. The effects of speech therapy thus seem encouraging, although more evidence is most welcome.

Table 1. Clinical Evaluation of Patients With Excessive Belching

History	Frequency of belching, occurrence of belching during sleep or during other activities, effect of stress, dysphagia, reflux symptoms, dyspepsia, signs of psychiatric comorbidity
Physical examination	Exclude other causes, thorough examination of neck and abdomen
Esophageal impedance monitoring	Supragastric belches in high frequency, normal air swallowing
Upper endoscopy on indication	

Given that excessive supragastric belching is a behavior disorder, cognitive behavior therapy seems a reasonable alternative approach.[20] The observation that distraction and stimulation influence the occurrence of belching supports this. The key is to provide the patient insight into the fact that supragastric belching is a learned behavior and, thus, it may be possible to unlearn this as well.

Both a speech therapist and a behavior therapist seem equipped for treatment of these patients. The choice of treatment depends on the available facilities. Hospitals with large Ear, Nose, and Throat departments where total laryngectomy is performed usually have well-trained speech therapists. After a laryngectomy with vocal cord resection, patients are taught to speak with the esophagus using supragastric belching. The speech therapists that train laryngectomized patients to perform esophageal speech may unlearn the same behavior in the patients with excessive supragastric belching. Alternatively, when there is local experience with behavior therapy, this seems most sensible. For both speech therapy and behavior therapy, it is of the utmost importance that the therapist has knowledge of the mechanism of supragastric belching and that therapy is aimed at reducing this. Therapists who are unaware of the mechanisms of supragastric belching still may think that excessive belching is the result of air swallowing and their therapy will not be very effective.

For the same reason, drugs that reduce surface tension such as dimethicone and simethicone are not useful in patients with excessive supragastric belching. A small study with baclofen, a γ-aminobutyric acid-B receptor agonist that reduces the frequency of TLESRs, showed that this drug reduced the number of supragastric belches.[21] Anecdotally, successful treatment of excessive belching has been reported in a few cases using hypnosis and biofeedback.[22–24]

Excessive Belching in Gastroesophageal Reflux Disease and Functional Dyspepsia

One of the most reported symptoms in patients with GERD next to heartburn and regurgitation is belching.[25] Excessive belching in patients with GERD can be caused by a high frequency of gastric belching; however, supragastric belching also has been observed in patients with GERD.[26] Patients with GERD swallow air more often and subsequently have more gastric belches than healthy subjects.[27] Acid-suppressive therapy reduces the frequency of air swallowing in patients with GERD in contrast to healthy subjects, which suggests that the unpleasant sensation of heartburn stimulates patients to take larger gulps and swallow more air. As expected, acid-suppressive therapy indeed reduces belching.[28] Symptoms of belching also respond to treatment with the TLESR-inhibitor baclofen.[29]

As mentioned previously, in a subset of patients with GERD, supragastric belching is seen on an impedance measurement; this can be asymptomatic.[26] In the GERD patients with severe belching symptoms, however, supragastric belches are usually the main determinant of these symptoms.[30]

Frequent belching is reported by 80% of the patients with functional dyspepsia.[31] Studies using impedance monitoring show that patients with functional dyspepsia swallow air more frequently than healthy subjects and have more gastric belches.[32] The presence of supragastric belches has not been studied in patients with functional dyspepsia. Frequent air swallowing in patients with functional dyspepsia is probably a response of the patient to unpleasant abdominal sensations. Frequent belching also has been reported in patients with organic disorders that cause abdominal discomfort or pain, such as peptic ulcer disease, pancreatitis, angina pectoris, and symptomatic cholecystolithiasis; however, in those conditions other symptoms usually are predominant.[33]

Inability to Belch

The physiologic importance of belching is illustrated by those patients who have an acquired inability to belch. After antireflux surgery, the newly made wrap around the LES prevents reflux by reducing the number of TLESRs and increasing the sphincter pressure during TLESRs.[34] Besides a large reduction in reflux episodes, the number of gastric belches is also greatly reduced and in some patients no belching is observed at all. The loss of the venting capacity of the stomach can lead to accumulation of air in the stomach and intestines and this results in bloating and increased flatulence.[35] These symptoms can be very severe and sometimes are the reason for a second surgery in which the normal anatomy is restored. We recently described that some patients start with supragastric belching after antireflux surgery in a futile attempt to vent gastric air to reduce symptoms of gas bloat.[36] The fact that a patient reports that he still is capable of belching after antireflux surgery thus cannot be taken as an indication that the venting capacity of the stomach is intact because the belching also can be caused by supragastric belching. The reduction in belching has been shown to be smaller after a partial fundoplication (270°, Toupet) than after a complete fundoplication (360°, Nissen).[37]

Very rarely, an inability to belch has been reported by patients with achalasia.[38] In achalasia the neurons that control motility of the esophageal smooth muscles are involved in a degenerative process. This generally results in aperistalsis and failure of the LES to relax. Very rarely, however, dysrelaxation of the UES also occurs, which makes it impossible for intraesophageal air to escape and, hence, belching has become impossible. Dilatation of the esophagus with air occurs and patients will experience thoracic pain; even airway obstruction has been described.[39,40]

In a similar way, a high threshold of the UES to relax can cause chest pain and it has been suggested that belching disorders play a role in some of the patients with noncardiac chest pain.[41] (Table 1).

Hiccups

Similar to belching, hiccups are common and usually occur occasionally. Only when multiple or prolonged episodes with hiccups occur is it considered pathologic. The medical term of hiccups is *singultus*. It is unknown whether hiccups serve a physiologic role.

Hiccups are involuntary spastic contractions of the respiratory muscles. Often only left unilateral diaphragmatic contractions are involved but sometimes both sides of the muscular diaphragm and the intercostal muscles are involved.

Hiccups can be classified based on duration. Hiccups lasting more than 48 hours are categorized as "persistent" and hiccups lasting more than 1 month are referred to as "intractable."[42]

Hiccups are mediated through a reflex arch consisting of afferent vagal, phrenic, and sympathetic nerves; central processing in the brainstem; and efferent signaling to the muscles of

diaphragm and intercostal muscles.[43] A lesion or stimulus that triggers one of the branches of this reflex arch can cause hiccups. For many listed causes of hiccups, the evidence is not overwhelming but some causes have been well documented, including a response to treatment of the underlying cause. For example, hiccups induced by a stroke disappeared after treatment with anticoagulant drugs, likewise it was described that hiccups disappeared after treatment of meningitis.[44–46] Not only can damage to the relevant nerves cause hiccups, but a supranormal stimulus also can induce hiccups. For example, distention of the esophagus or stomach with air or food, drinking hot fluids, and also gastroesophageal reflux and angina pectoris can cause hiccups.[47–51] It has been described that hiccups were initiated by supragastric belching.[52] It also has been described that patients develop hiccups after placement of a central venous line, placement of an esophageal stent in a patient with esophageal cancer, bronchoscopy, and during electrical pacing of the left atrium.[53–55] Hiccups also can be associated with uremia.[56] A list of described causes of hiccups can be found in Table 2.[57] It is likely that the listed systemic factors induce hiccups by triggering the central nervous system as well (Tables 2 and 3).

Management of Hiccups

Most episodes with hiccups are transient and self-limiting and may never need evaluation or treatment. When hiccups start during invasive procedures such as bronchoscopy or during infusion of anesthetics or chemotherapy, the underlying cause is identified easily. However, sometimes the trigger cannot be identified immediately and a search for an underlying cause is warranted. The clinical evaluation of a patient with persistent or intractable hiccups is found in Table 3. Of these investigations, magnetic resonance image of the brainstem and esophageal manometry and 24-hour impedance–pH monitoring are not always indicated and can be performed in case there are additional symptoms or signs that suggest a central or esophageal cause. When this yields a treatable cause, the problem can be solved but sometimes a causative factor is never found or, sometimes, in particular in patients in whom cancer is the cause of hiccups, a purely symptomatic treatment is indicated. Physical maneuvers as described in Table 4 usually already have been tried and are not useful anymore in this stage[58] (Table 4).

There are various reports on the medical treatment of hiccups, but few of the available drugs have been tested in a controlled study. Choice of treatment thus is based mainly on anecdotic reports and expert opinion, although the effect of some drugs is very likely, other reports describe an unlikely relation between drug and effect or an unlikely effect in itself.

Table 2. Causes of Intractable Hiccups

Peripheral nerve stimulation
Gastrointestinal
Esophageal distention, GERD
Gastric ulcer, gastric distention
Pancreatitis
Cholecystolithiasis
Cardiovascular
Myocardial infarction
Pericarditis
Local nerve compression
Goiter
Tumor
Mediastinal lymph nodes
Abscess
Instruments (intubation, catheters, stents)
Local nerve infection (herpes)
Pulmonary
Pneumonia
Asthma
Lung tumors
Central nervous system
Vascular
Tumor
Inflammation
Trauma
Infection
Uremia
Systemic factors
Medication and drugs
Electrolyte disturbances
Alcohol

Table 3. Clinical Evaluation of Patients With Intractable Hiccups

History	Other symptoms, duration of symptoms and triggers, medication use, illicit drug use
Physical examination	Full physical examination including ear, nose, and throat and neurologic evaluation
Blood test	Blood count, electrolytes, urea, cortisol, amylase, lipase, liver function tests, C-reactive protein
Electrocardiogram	
Computed tomography of the chest	
Upper endoscopy	
Magnetic resonance image of the brain stem	
Esophageal manometry and 24-hour impedance–pH monitoring	

Table 4. Physical Maneuvers and Folk Remedies for Hiccups

Maneuver	Effect
Scaring the patient	Vagal stimulation
Rapid uninterrupted drinking	Stimulating nasopharynx and esophagus
Eyeball compression	Vagal stimulation
Breath holding	Interruption of respiratory cycle
Supramaximal inspiration	Inducing hypercapnia
Intranasal vinegar instillation	Stimulating nasopharynx
Swallowing sugar	Stimulating nasopharynx and esophagus
Biting a lemon	Stimulating nasopharynx and esophagus
Carotid massage	Vagal stimulation

The most well-known drug for the treatment of intractable hiccups is chlorpromazine.[59] In the United States, this is the only agent approved for this indication, meaning that all other drugs are used off-label. Chlorpromazine is started in a low dose (25 mg 3–4 times/d) and the dose can be increased when side effects allow it. Common side effects are drowsiness and sleepiness and, more rarely but also more serious, sometimes tardive dyskinesia can be encountered. GABA agonists baclofen and gabapentin are both described as being effective in 3 of 4 patients with intractable hiccups, but side effects such as dizziness and sleepiness may limit chronic use of these drugs.[60,61] Baclofen is started in a dose of 5 mg 4 times/d and this can be increased slowly. Case reports also have suggested the use of other drugs such as carvedilol, metoclopramide, nefopam, amantadine, olanzapine, and midazolam, although the latter also can induce hiccups when used as a sedative.[62–64] Marijuana also has been described as being effective in the treatment of intractable hiccups.[65]

In case hiccups are intractable and no alleviation is obtained with medical therapy, one can resort to ultrasound-guided nerve blockade or surgical section of the phrenic nerve. A case series described a successful implantation of an implantable breathing pacemaker that stimulates the phrenic nerve.[66] There are also reports on the use of hypnosis and acupuncture.[67–69]

Aerophagia

Aerophagia refers to the disorder in which patients swallow air so frequently in such large quantities that it results in symptoms.[17] Part of the swallowed air is vented through gastric belches and part of the air reaches the intestines where it causes abdominal distention and bloating. Some cases of children with mental disabilities have been described in which extreme volumes of swallowed air resulted in extreme dilatation of the stomach and intestines followed by gastric volvulus, ileus, and breathing difficulties.[70–72]

Bloating and abdominal distention are very common symptoms in patients with irritable bowel syndrome, functional dyspepsia, and constipation, but true aerophagia is very rare. In 2009, the first report in which the existence of a syndrome of excessive air swallowing in patients with symptoms of bloating and distention and signs of excessive intestinal air on abdominal radiographs was unambivalently shown was published in this journal.[73] By using impedance monitoring, it was observed that a group of patients with isolated excessive intestinal gas and symptoms related to this showed excessive air swallowing.

Table 5. Clinical Evaluation of Patients With Aerophagia

History	Bloating, belching, flatulence, distention, constipation, abdominal pain. Absence of vomiting
Physical examination	Increased tympany over the abdomen, normal bowel sounds, no signs of ileus
Abdominal radiograph	Distended bowels, large volume of intestinal air, absence of air-fluid levels
Esophageal impedance monitoring	Excessive gastric belches and air swallowing, no supragastric belches
Upper endoscopy only on indication	

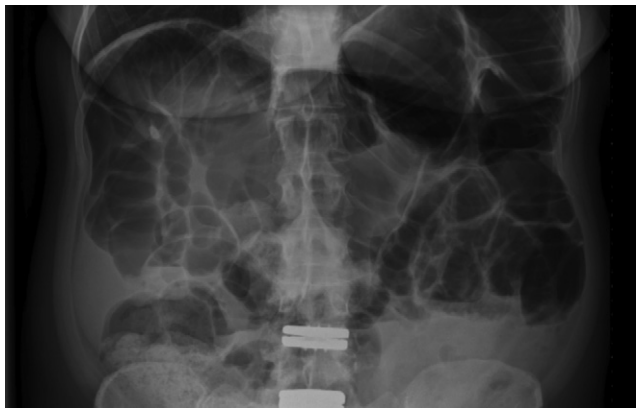

Figure 2. Abdominal radiograph of a patient with aerophagia showing a large volume of intestinal and colonic air; there are some signs of constipation as well but no air-fluid levels. Impedance monitoring showed massive air swallowing.

Other symptoms besides bloating were flatulence, abdominal or epigastric pain, and constipation. Gastric belching is usually not the predominant symptom in these patients and supragastric belching is not observed at all in patients with aerophagia. In some patients with true aerophagia, episodes of air swallowing and symptoms can be distinguished followed by episodes without complaints. In such episodes patients report abdominal distention accompanied by pain and belching (Table 5). A differential diagnose with a mechanical ileus can be difficult and 30% of our patients have undergone a negative explorative laparotomy after presentation at the emergency room. In retrospect, the abdominal radiographs showed distended intestinal loops but no air-fluid levels and thus no evidence of obstruction (Figure 2). Laparotomy thus should be avoided in these patients.

In irritable bowel syndrome and constipation, an increased volume of intestinal air can be found as well and various causes such as differences in intestinal gas handling, malabsorption, and bacterial overgrowth all have been suggested to play a role.[74,75] Increased air swallowing, however, is not observed in IBS.

Management of Aerophagia

The treatment of aerophagia is based mainly on expert opinion because no controlled trials are available. For the management of aerophagia, we make a distinction between patients with aerophagia who have chronic stable symptoms and patients with acute and severe episodes of aerophagia in which it can lead to a threatening situation. The latter mainly occurs in mentally disabled patients and can result in volvulus of organs and obstruction and breathing difficulties owing to increased abdominal pressure. In that case a nasogastric tube to relieve gastric air seems reasonable and sedatives such as lorazepam may help to reduce repetitive air swallowing.

In the majority of patients, the symptoms are more chronic and in these patients a different approach is warranted. It is advisable to restrict the use of carbonated beverages and eat slowly. Similar to patients with excessive supragastric belching, treatment with speech therapy seems sensible but no published reports on this are available. The aim of speech therapy for aerophagia is to reduce air swallowing, and this is thus a

different approach compared with the treatment of supragastric belching.

Surface-reducing drugs such as dimethicone and simethicone prevent gas formation in the intestines and may alleviate symptoms as well. In case of constipation secondary to intestinal and colonic distention, the use of laxatives is indicated (Table 5).

Conclusions

Belching and hiccups occur occasionally and are regarded as normal behavior. However, when belching or hiccups occur in high frequency or become persistent this can become very bothersome and a reason for consultation. In a patient with excessive belching, gastric and supragastric belches are distinguished and this distinction has consequences for therapy. Excessive belching is a behavioral disorder and should be treated as such. Persistent hiccups can be the first presentation of serious disorders and an underlying cause should be searched for. When no underlying cause is found, treatment is symptomatic.

Aerophagia is a disorder in which patients swallow too much air; this air accumulates in the stomach, intestines, and colon, and causes abdominal distention and bloating. Not only children but also adults can suffer from this disorder. Aerophagia can occur in sudden attacks but also more chronically. It is important that explorative laparotomies are avoided in these patients because they do not suffer from an ileus. Now that patients with aerophagia can be identified, the search is for an effective treatment.

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