

Title of the Article-Intestinal Gas

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Intestinal gas is mainly composed of nitrogen, oxygen, carbon dioxide, hydrogen and methane. Various complaints attributed to it are belching, flatulence abdominal bloating and abdominal distension. In patients with isolated symptoms of excessive belching, psychological and behavioral factors play an important role. Belching is also associated with gastroesophageal reflux disease (GERD) and functional dyspepsia. We should always rule out alarm features in evaluation of patients such as weight loss, bleeding per rectum, nocturnal abdominal pain diarrhoea and investigate further. Rome IV criteria for establishing the diagnosis of functional bloating should be used. Management of various disorders due to intestinal gas include education, treatment of associated disorders, behavioral therapy, dietary modifications and drugs.

Keywords: Intestinal Gas; Belching; Flatulence; Abdominal distension; Bloating**Abbreviations**

N₂: Nitrogen; O₂: Oxygen; CO₂: Carbon Dioxide; H₂: Hydrogen; CH₄: Methane; GERD: Gastroesophageal Reflux Disease; FOD-MAPS: Fermentable Oligosaccharides Disaccharides Monosaccharides and Polyols

Introduction

Gastrointestinal complaints are commonly attributed by the patient to gas. Excessive intestinal gas occur due to excessive air swallowing, increased intraluminal production from malabsorbed nutrients, decreased gas absorption due to obstruction or dysfunctional gas clearance, or expansion of intraluminal gas due to changes in atmospheric pressure.

Volume and composition of intestinal gas

The volume of gas in the intestinal tract is approximately 200 mL in both the fasting and postprandial states in both normal sub-

jects and individuals who complain of gaseous distention [1]. Nitrogen (N₂), oxygen (O₂), carbon dioxide (CO₂), hydrogen (H₂), and methane (CH₄) account for more than 99 percent of expelled intestinal gas [1]. The composition of gas within the intestinal tract is predominantly N₂ [1]. Oxygen is present in very low concentrations, and the concentrations of CO₂, H₂, and CH₄ vary among individuals.

Sources of intestinal gas**Air swallowing**

Aerophagia is the major source of stomach gas. Larger amounts are swallowed when food is gulped. Aerophagia can be a manifestation of anxiety, and is increased with gum chewing and smoking. Most swallowed air appears to be eructated [2]. Swallowed air is the major source of O₂ and N₂ in intestinal gas. Posture may influence the amount of swallowed air passing from the stomach into the small intestine. The supine position causes gastric air to pass

preferentially into the small intestine as gastric air is located above liquid gastric contents that overlie the gastroesophageal junction.

Intraluminal production

Three of the five principal gases, CO₂, H₂, and CH₄, are produced within the bowel lumen.

- **CO₂:** CO₂ is derived from digestion of fat and protein in the upper gastrointestinal tract, from bacterial fermentation of intraluminal substrates, or may be liberated from the interaction of acid and bicarbonate [3]. Much of the CO₂ produced in the upper small intestine is probably absorbed before it reaches the colon. CO₂ that is present in flatus is likely due to bacterial fermentation reactions in the colon. Increased CO₂ in flatus can result from specific dietary substrates, such as nondigestible carbohydrates [4].
- **H₂:** H₂ is both produced and consumed by fecal bacteria; the net H₂ excretion is determined by these two processes. H₂ production occurs predominantly in the colon [5]. Ingested carbohydrate and protein are sources for H₂ production. In healthy individuals, certain foods with high concentrations of oligosaccharides found in legumes, or resistant starches (flours made from wheat, oats, potatoes, and corn), cannot be completely digested by enzymes within the normal small bowel, leading to increased H₂ production [6].
- **Methane:** Methane, like H₂, is exclusively a product of bacterial metabolism. The presence of bile acid in the colon also may be important in the regulation of methanogenesis [7].
- **Causes of increased intestinal gas:** When excessive intestinal gas occurs, it may be due to excessive air swallowing, increased intraluminal production from malabsorbed nutrients, decreased gas absorption due to obstruction, or expansion of intraluminal gas due to changes in atmospheric pressure.

Clinical manifestations of intestinal gas

Belching

Belching or eructation is defined as an audible escape of air from the esophagus or the stomach into the pharynx [8]. It may be voluntary or involuntary. Involuntary belching typically follows a meal and is caused by the release of swallowed air after gastric distention. Belching is only considered a disorder when it is excessive and becomes troublesome.

In patients with isolated symptoms of excessive belching, psychological and behavioral factors play an important role. Belching is also associated with gastroesophageal reflux disease (GERD) and functional dyspepsia [9].

Diagnostic approach

Evaluation

Belching disorder is a functional syndrome, and the diagnosis is based on a history. Observation of air swallowing provides supportive information. Patients who complain of isolated excessive belching are more likely to suffer from excessive uncontrolled supragastric belching, and from episodes of frequent belching in which they may belch up to 20 times per minute.

The presence of alarm features including weight loss, abdominal pain, dysphagia, heartburn, and regurgitation are an indication for further diagnostic evaluation with upper endoscopy and/or imaging (eg, abdominal computed tomography (CT) scan).

Diagnostic criteria for functional belching

According to the Rome IV criteria, belching disorder is defined as bothersome (ie, severe enough to impact usual activities) belching from the esophagus or stomach more than three days a week [10]. These criteria should be fulfilled for the last three months with symptom onset at least six months before diagnosis.

Management

- **Education, treatment of associated disorders, and behavioral therapy:** Management includes education to decrease air swallowing and reassurance that belching is a benign condition. Specific behavioral measures include discontinuation of gum chewing, smoking, drinking carbonated beverages, and gulping foods and liquids. In patients with underlying depression or anxiety, treatment should be initiated [11]. Patients with co-existing acid reflux may require acid suppressive therapy for management of GERD.

Successful treatment of excessive belching by a therapist (eg, cognitive behavioral therapist or speech therapist) with special training in diaphragmatic breathing techniques has been associated with a reduction in symptoms in small observational studies [12,13].

- **Reflux inhibitors for refractory symptoms:** Baclofen (10 mg three times daily) by reducing transient lower esophageal sphincter relaxations and centrally suppressing the swallowing rate, may decrease both supragastric and gastric belching [14].

Flatulence

The volume of gas passed per rectum varies from about 500 to 1500 mL per day [15]. The frequency of flatus released varies between 10 and 20 times per day in healthy subjects [16]. Most individuals who report excessive flatulence fall within this range.

Diagnostic evaluation

Evaluation of the patient complaining of flatulence should be guided by the history and physical examination. A dietary history should be obtained with a focus on gas-producing foods and beverages.

Alarm features

Alarm features in patients with flatulence include the following:

- Nocturnal abdominal pain
- Weight loss
- Hematochezia
- Systemic symptoms including weight loss or fever
- Diarrhea or steatorrhea
- Vomiting
- Severe abdominal tenderness, organomegaly, or succussion splash on physical examination.

New onset of flatulence associated with alarm symptoms such as diarrhea and abdominal pain should be evaluated for malabsorption. Stool examination for fat and *Giardia*, breath tests for small intestinal and lactose intolerance, celiac serology, and endoscopic evaluation. In the absence of alarm features, additional evaluation is not required.

Management

Several measures that can be undertaken to reduce flatulence include:

- **Treatment of the underlying cause** – In individuals with lactose intolerance, management includes lactose restriction and the use of enzyme preparations that are taken orally with lactose-containing foods. In patients with small bowel bacterial overgrowth, treatment is with antibiotic therapy
- **Dietary modification** – Patients should be advised to avoid gas-producing foods (eg, cabbage, onions, broccoli, brussels sprouts, wheat, and potatoes). In patients without a significant improvement despite exclusion of gas-producing foods, a diet low in fermentable oligosac-

charides, disaccharides, monosaccharides, and polyols (FODMAPs) [17,18].

- **Other interventions** – Other interventions that have not consistently demonstrated efficacy in the prevention or management of flatulence include anti-flatulence medications (eg, simethicone and activated charcoal) and alpha-galactosidase enzyme preparation [19,20].

Bismuth subsalicylate reduces the odor arising from hydrogen sulfide as well as other pungent components of flatus [21].

Abdominal bloating and distension

Bloating refers to a sensation of abdominal fullness, pressure, or a sensation of trapped gas, whereas distention is a measurable increase in abdominal girth. Bloating and distension have been reported in 20 to 30 percent of the general population and in up to 96 percent of patients with irritable bowel syndrome (IBS) [22-24].

Evaluation

Bloating and distension may be caused by organic disease or other functional gastrointestinal disorders. A clinical diagnosis of functional bloating/distension requires the fulfillment of symptom-based diagnostic criteria and a limited evaluation to exclude underlying organic disease.

Diagnostic criteria for functional bloating/distension

Rome IV criteria for establishing the diagnosis of functional bloating include both of the following (for at least three months with symptom onset at least six months prior to diagnosis) [25].

- Recurrent bloating or distension, on average, at least one day per week; abdominal bloating and/or distension predominates over other symptoms
- Insufficient criteria for a diagnosis of IBS, functional constipation, functional diarrhea, or postprandial distress syndrome.

Mild pain related to bloating may be present as well as minor bowel movement abnormalities.

Management

- **Dietary and lifestyle modification:** Approach to treatment of abdominal bloating and distension is similar to that used in patients with IBS. Patients are advised to avoid foods that increase flatulence (eg, beans, onions, celery, carrots, raisins, bananas, apricots, prunes, Brus-

sels sprouts, wheat germ, pretzels, and bagels). We suggest a diet low in FODMAPs in patients with persistent symptoms despite exclusion of gas-producing foods. Other dietary modifications that may be helpful include restriction of carbonated drinks. Mild exercise and erect posture may improve bloating in some patients [26-28].

- **Treatment of the underlying cause:** In patients with small intestinal bacterial overgrowth antibiotic treatment is indicated. In individuals with lactose intolerance, management includes lactose restriction and the use of oral enzyme preparations with lactose-containing foods. Anticholinergic agents, opiates, and calcium blockers should be avoided because of their effects on gut motility
- **Biofeedback:** In patients with functional abdominal distension, biofeedback may decrease distension [29].
- **Other therapies:** Other therapies lacking clear evidence of efficacy in decreasing bloating/distension include antifoaming agents (eg, simethicone), adsorbents (eg, activated charcoal), and probiotics [30]. Although probiotics have been associated with an improvement in symptoms in patients with IBS, the magnitude of benefit and the most effective species and strain are uncertain.

Conflict of Interest

None.

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