Clinical Investigations from the RACP

Abdominal bloating
Is it all in the gas?

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Bloating is a common problem that is usually functional, but investigations to exclude organic disease may be needed depending on patient age and symptoms and signs. Treatment should be individualised and usually begins with dietary changes, followed by a short-term trial of medications if needed.

KEY POINTS

- Bloating is a common presenting symptom of functional gastrointestinal (GI) disorders, occurring either in isolation (functional bloating) or as part of a disorder such as irritable bowel syndrome (IBS); more rarely, it is a manifestation of an organic disease.
- The underlying pathophysiological mechanisms for bloating have been difficult to define but likely involve retained intraluminal gas, altered GI motility and visceral hypersensitivity.
- Functional bloating and bloating as a manifestation of IBS can usually be diagnosed clinically, but judicious use of investigations to exclude organic disease should be considered.
- Treatment of functional bloating is challenging; a trial of lifestyle and dietary changes is appropriate, including a diet low in FODMAPs (fermentable oligosaccharides, disaccharides, monosaccharides, and polyols), with dietitian overview.
- A trial of simple measures such as proton-pump inhibitors, the herbal mixture Iberogast, peppermint oil capsules or probiotics might be beneficial in some patients.

Abdominal bloating is a common presenting symptom in patients in general practice and describes the subjective sensation of abdominal distension with or without an actual increase in abdominal girth. Patients commonly use the term loosely to describe associated symptoms such as belching, borborygmi and excessive flatus, as well as subjective abdominal distension. A recent survey from the USA found that almost 20% of the general population experiences abdominal bloating.[1] Surveys have found that almost half to three quarters of patients with bloating reported a concomitant increase in abdominal girth.[2]

Bloating may be a symptom of an organic disease such as coeliac or inflammatory bowel disease or ovarian cancer. However, it is also a frequent complaint in patients with functional gastrointestinal (GI) disorders, occurring either in isolation – termed functional bloating – or as part of another disorder such as irritable bowel syndrome (IBS), functional dyspepsia or functional constipation. Indeed, bloating can affect up to 96% of individuals with IBS.[2] Functional bloating is defined by the Rome III diagnostic criteria for functional GI disorders as a recurrent feeling of bloating or visible distension at least three days per month in the past three months, with insufficient criteria for a diagnosis of functional dyspepsia, IBS or other functional GI disorder.[3]

Patients often attribute bloating and associated symptoms solely to the production of intestinal gas. Although much research has focused on the role of intestinal gas in bloating, other factors such as distorted perception, changes in other intra-abdominal

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contents and visceral reflexes also play an important role.

Mechanisms of bloating

The aetiology of bloating and abdominal distension is multifactorial. Factors that are suggested to contribute to bloating are summarised in Figure 1.[4] It is thought to involve a combination of:

- retained abdominal gas
- impaired GI motility
- visceral hypersensitivity
- malabsorption.

In patients with IBS, bloating is quite often associated with symptoms such as constipation or diarrhoea. Bloating can also occur in healthy individuals, especially after overindulgence in large meals. This self-induced bloating is rarely a cause for concern or medical consultation. Generally, patients easily connect the bloating sensation to excess eating and experience spontaneous relief, usually in a few hours.

Gastrointestinal gas

The GI tract (GIT) is about eight metres in length, but the total volume of GI gas is only about 100 to 200 mL.[5] Major sources of GI gas are illustrated in Figure 2 and discussed below.

Aerophagia

Swallowed air is a major source of GI gas. Much aerophagia occurs during eating and drinking and can be a source of bloating in those who are sensitive to the effects of excess gas. Aerophagia may also occur with anxiety or repetitive attempts to induce belching, which may actually increase the amount of air swallowed. Carbonated beverages can introduce a large amount of gas into the stomach and, although carbon dioxide is generally well absorbed in the small bowel, can cause symptoms in sensitive patients.

Intestinal production of gas

The GIT contains a complex ecosystem of numerous micro-organisms, which are vital for maintenance of its function and integrity. The gut bacteria produce gas through the fermentation of complex carbohydrates and nonabsorbable fibre.

Carbon dioxide is mainly produced in the upper GIT by the interaction between gastric acid and bicarbonate in pancreatic juice. This chemical reaction is the result of fat, carbohydrate and protein metabolism and occurs rapidly when food reaches the duodenum. Carbon dioxide is highly soluble and is rapidly absorbed in the upper GIT but may contribute to bloating in some patients, especially those with altered GI transit (see below).

Hydrogen and methane are produced mainly in the colon by fermentation of food residue by the gut microflora, whose composition is largely determined by dietary and environmental factors but remains fairly stable throughout life. Oligosaccharides and resistant starches (e.g. potatoes, oats) are not completely digested in the small bowel and are metabolised by bacteria in the large bowel, producing large quantities of hydrogen and carbon dioxide. These gases are then consumed by colonic bacteria to produce methane. The balance between gas-producing and gas-consuming micro-organisms determines the net production of gas.

The distribution of the three gases varies at different points in the GIT and at any time, depending on GI gas-handling mechanisms such as absorption and expulsion as flatus.

Gastrointestinal gas and symptoms

The net amount of gas in the GIT at any time is the sum of the amounts swallowed and produced in the GIT lumen minus the amounts absorbed and expelled by belching and flatus. Despite the common belief of both patients and clinicians that excessive GI gas is the cause of bloating, experimental studies using a variety of gas washout techniques have failed to detect any significant differences in gas volume between people with abdominal bloating and healthy control subjects.[6] In a study of patients given a direct infusion of gas into the GIT, those with a history of bloating developed not only greater symptoms but also greater objective abdominal distension than healthy subjects.[7] These studies suggest that although excessive intraluminal gas appears a plausible cause of abdominal bloating and distension, there must be other contributing factors.

Altered gastrointestinal transit

Slowed transit of food in the upper GIT may cause bloating by several mechanisms. Firstly, in patients with acquired causes of slowed transit such as diabetes-related gastroparesis or abdominal surgery (e.g. partial gastrectomy, especially with concomitant vagotomy), the movement of ingested food to the rest of the GIT is delayed, leading to stasis and a physical increase in the intraluminal content.

Secondly, slowed transit may lead to small bowel bacterial overgrowth – an imbalance in the quantity and distribution of bacteria. The duodenum and proximal jejunum normally contain very few bacteria; small bowel bacterial overgrowth prolongs the fermentation of food residue, leading to excessive gas production. Other causes of slowed GI transit include hypothyroidism, scleroderma and use of medications such as opioids and some antidepressants.

A large proportion of patients with bloating complain that their symptoms worsen as the number of days without a bowel motion increases. In patients with constipation, the incidence of bloating may be up to 80%.[8] IBS can be classified by the patient's predominant GI symptom – constipation (IBS-C) or diarrhoea (IBS-D) dominant. Patients with IBS-C are thought to retain more gas than those with IBS-D, because of the slower intestinal transit of fluid and gas and subsequent expulsion through defaecation and flatus. Patients with IBS-C have been found 14 times more likely to have bloating or distension than control subjects.[9] However, the relationship between GI transit patterns and bloating is far from clear cut, with bloating seen in both patients with IBS-C and those with IBS-D, which are associated with slow and rapid GI transit, respectively.[10]

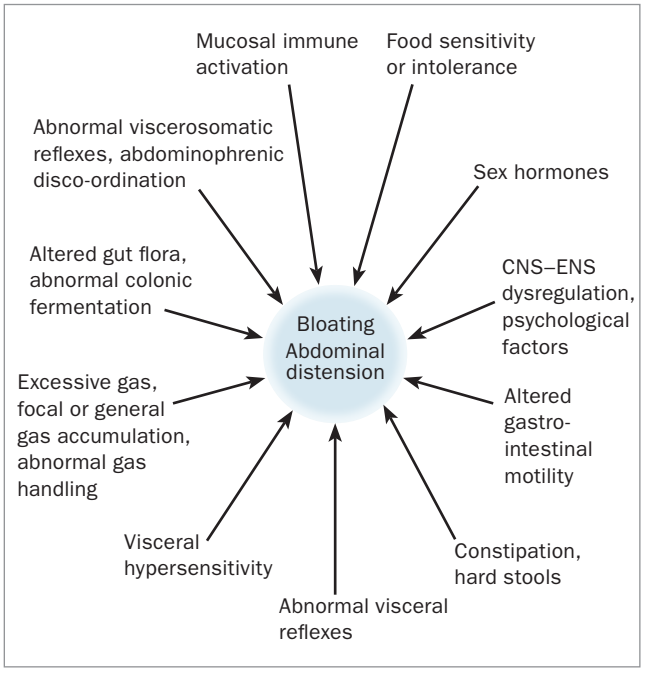

Figure 1. Factors that may contribute to abdominal bloating.[4]

ABBREVIATIONS: CNS = central nervous system; ENS = enteric nervous system.

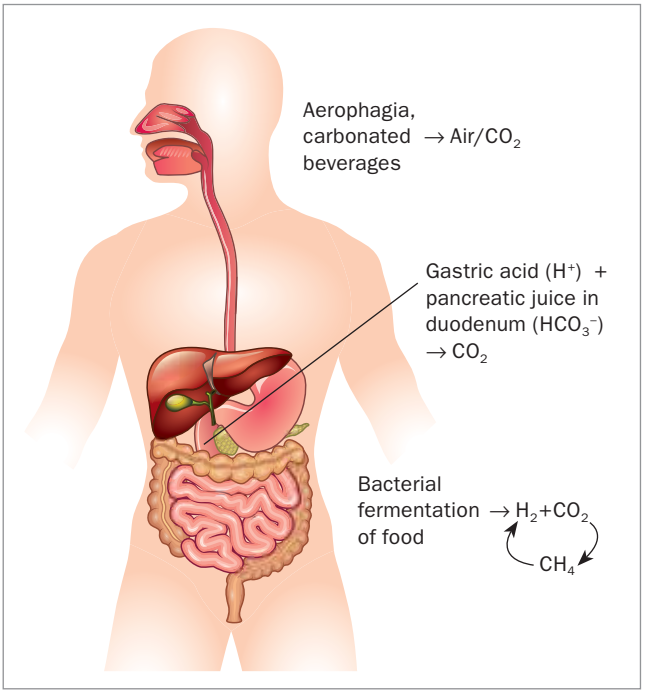

Figure 2. Major sources of gastrointestinal gas.

Visceral hypersensitivity

Visceral hypersensitivity relates to the way the central nervous system (CNS) interprets changes in total abdominal content and girth. Signals emanating from the abdomen, such as changed tone of the abdominal wall muscles and diaphragm, have been shown to be important in the perception of bloating.[11] More importantly, the way that the CNS perceives these changes in sensory input from the GIT can also be a significant contributing factor to patients' perception of their symptoms.

The GIT–brain interactions are complex. It is believed that abdominal symptoms can influence anxiety and depression, and conversely psychological factors can influence GI pain perception and motor functions.[12] Psychiatric diagnoses, especially anxiety, depression and somatisation, have been shown to be strong predictors of healthcare seeking.[13] Stress, personal experiences and psychological problems may produce physical complaints that prompt patients to seek medical attention. For example, depression may lead to anorexia, bloating and weight loss. Anxiety and depression were shown in a recent meta-analysis to be significantly more common in patients with IBS than in healthy control subjects.[14] In fact, some studies have shown that up to 60% of patients with IBS have major psychosocial problems.[15] Consequently, patients with IBS should be routinely checked for psychiatric comorbidities and treated accordingly.

Malabsorption of carbohydrates

Lactose intolerance is the most common subtype of carbohydrate malabsorption and is frequently found in patients with IBS. It is related to low lactase activity. Lactase is an enzyme located in the villous membrane of small bowel cells, where it hydrolyses lactose to glucose and galactose, which are then absorbed by the cells.

Similarly, malabsorption of other carbohydrates, such as fructose and sorbitol, can increase bloating and abdominal distension. Malabsorption increases osmotic load, thereby increasing intraluminal fluid content and altering the variety of GI bacteria flora and GI motility (see Box 1).[16]

Investigation of bloating

A thorough clinical history and physical examination are needed to clarify what the patient means by bloating and to ensure that organic disease is excluded before bloating can be considered to be functional. The need for investigations depends on the patient's age and associated symptoms. The differential diagnosis of bloating is shown in Box 2, and 'red flag' signs and symptoms that warrant further investigations are listed in Box 3.

Some patients who complain of bloating have associated symptoms such as constipation, urgency, crampy abdominal pain or increased stool frequency. These symptoms generally increase the likelihood that IBS is the underlying cause and decrease the need for detailed investigation unless other concerning symptoms or signs are present.

Haematology and biochemistry tests

Iron studies and measurement of red cell folate and vitamin B_{12}, calcium, albumin and vitamin D levels can provide clues to a malabsorptive disorder. Anaemia,

1. ROLE OF FODMAPS IN SYMPTOMS OF IRRITABLE BOWEL SYNDROME[16]

1. Poorly absorbed FODMAPs are presented to the small bowel and colon
2. Water is drawn into the lumen through osmosis
3. Bacterial fermentation of FODMAPs in the colon leads to gas production and abdominal bloating

ABBREVIATION: FODMAPs = fermentable oligosaccharides, disaccharides, monosaccharides and polyols.

2. DIFFERENTIAL DIAGNOSIS FOR BLOATING

- Functional gastrointestinal disorder (e.g. irritable bowel syndrome)
- Peptic ulcer disease
- Coeliac disease
- Inflammatory bowel disease (e.g. Crohn's disease)
- Pancreatic insufficiency
- Lactase deficiency
- Small bowel bacterial overgrowth after abdominal surgery such as partial gastrectomy, Whipple procedure (pancreaticoduodenectomy)
- Gastrointestinal or gynaecological malignancy
- Ascites (e.g. decompensated liver cirrhosis, cardiac failure, metastatic gynaecological and gastrointestinal malignancies with malignant ascites, atypical infections such as tuberculosis)

especially if associated with iron deficiency and weight loss, should prompt consideration of occult GI malignancies.

Coeliac disease can manifest in a number of ways, including diarrhoea after ingestion of gluten or unintentional weight loss. Tests for IgA antibodies to tissue transglutaminase (TTG) and deamidated gliadin peptide have very good sensitivity and specificity for the diagnosis of coeliac disease. Total immunoglobulin IgA should also be measured, as 2 to 3% of patients with coeliac disease have selective IgA deficiency.[17] In that case, tests for IgG antibodies to TTG and gliadin should be ordered. These tests are Medicare funded. They are more specific and sensitive and have superseded antiendomysial antibody testing, which was previously part of the routine screen for coeliac disease.

Abdominal ultrasound and computed tomography

Ultrasound is useful for the assessment of solid intra-abdominal organs and ascites. It is, however, operator dependent, and views may be obscured by excess bowel gas. It is a relatively inexpensive test and does not have any associated radiation. CT scans are more useful for the diagnosis of solid organ malignancies.

Stool microscopy and culture

Stool microscopy and culture are generally ordered for patients with an acute diarrhoeal illness that has lasted more than a few days. Enteropathic organisms such as salmonella, campylobacter and giardia can cause bloating before the onset of diarrhoea. Post-infectious IBS can also cause abdominal bloating but is usually self-limiting.

Faecal calprotectin

Calprotectin is a protein released from neutrophils in response to inflammation or infection of the GIT. Measurement of faecal calprotectin is useful for differentiating inflammatory bowel disease from IBS but is not currently Medicare funded.

Gastroscopy and colonoscopy

Peptic ulcer and gastric cancer can cause abdominal bloating and should be ruled out by gastroscopy and/or a urea breath test for *Helicobacter pylori* (for peptic ulcer) or gastroscopy (for gastric cancer) if the symptoms are suggestive. The gold standard for the diagnosis of coeliac disease is small bowel biopsy while the patient is ingesting a gluten-containing diet. Small bowel biopsy can also be undertaken to assess for lactase deficiency, which may give rise to lactose intolerance. However, lactose intolerance can also occur in patients with normal small bowel lactase activity.[18] Colonoscopy with biopsies needs to be considered to exclude inflammatory bowel disease, microscopic colitis and GI malignancies.

3. GASTROINTESTINAL SIGNS AND SYMPTOMS THAT WARRANT FURTHER INVESTIGATION

- Unexplained weight loss
- New symptoms such as abdominal pain (less than six months' duration)
- Recent changes in bowel habit
- Nocturnal symptoms (i.e. waking from sleep with symptoms)
- Fever
- Gastrointestinal bleeding
- Age over 50 years at onset
- Abdominal mass

Management of bloating

Management of patients with bloating attributed to IBS usually involves control of associated symptoms such as pain, constipation and diarrhoea. The evidence base for most pharmacological treatments including prokinetics, which alter GI transit, and surfactants such as simethicone, is generally weak. However, exclusion diets such as a diet low in FODMAPs (fermentable oligosaccharides, disaccharides, monosaccharides, and polyols) have shown promising results.[16] Gluten sensitivity in the absence of coeliac disease as a cause of bloating and diarrhoea is controversial. Clinical trials have produced different results with respect to the effect of gluten on bloating and other symptoms in patients with IBS.[19,20]

Given the heterogeneity of bloating-associated symptoms across the population, treatment should be tailored for each individual. Various treatment options may be tried, usually starting with lifestyle and dietary modification, followed by a short-term trial of pharmacological therapies.

Lifestyle modification

Bloating can be associated with eating habits, such as eating rapidly, while 'on the go' or while watching television. Patients should be encouraged to identify the triggers for their symptoms themselves, whether they be the type of food or style of eating. This allows them ownership of their symptoms and treatment by altering eating behaviours and avoiding triggers.

Dietary modification

Fibre

The effect of fibre is controversial in bloating and its use may worsen symptoms in some patients. General advice is often given to increase daily fibre intake, especially in those with constipation. However, this can be counterintuitive for patients with diarrhoea as their predominant symptom, as it will increase the amount of water drawn into the lumen. A short trial of fibre is not unreasonable but should not be pursued if it clearly does not improve the patient's symptoms.

FODMAPS

FODMAPs are poorly absorbed short-chain carbohydrates that are thought to give rise to abdominal symptoms through osmotic effects and gas production via bacterial fermentation (Box 1). On this premise, a diet that is low in FODMAPs has been proposed as first-line management in patients with IBS. In a recently published randomised controlled crossover study, patients with IBS had fewer symptoms of bloating and abdominal pain while eating a low-FODMAP diet than while eating a typical Australian diet.[21]

Flatulogenic foods

Avoidance of 'flatulogenic' foods may improve bloating symptoms. These include:

- foods that contain complex carbohydrates, such as rice, potatoes, beans and lentils
- carbonated beverages, as they increase the delivery of carbon dioxide to the small intestine
- artificial sweeteners containing sorbitol and fructose, which are incompletely absorbed in the small bowel and undergo fermentation in the colon.

A consultation with an experienced dietitian is valuable to identify flatulogenic foods and ensure a balanced diet is followed.

Pharmacological therapy

Proton-pump inhibitors

Proton-pump inhibitors, although TGA approved only for reflux and peptic ulcer treatment, are warranted for a four-week trial in patients with functional bloating, as it might be a manifestation of reflux or peptic ulcer disease. The need for appropriate investigations for these conditions should be kept in mind.

Antispasmodics

As a class, antispasmodics have been shown to be of benefit in the treatment of IBS and associated symptoms.[22] They should, however, be used only for short-term relief of symptoms. Examples include hyoscine and mebeverine. Side effects of these medications include dry eyes, dry mouth and constipation.

Prokinetics

Prokinetics may alter the distribution of gas in various parts of the GIT without detectable changes in total gas content.[23] Newer agents such as prucalopride, a selective serotonin ($5HT_4$) agonist, have been shown to be effective in chronic constipation. Prucalopride is available in Australia only on private script for refractory constipation.[24]

Antibiotics

Rifaximin is a nonabsorbable antibiotic that was shown to be more effective than placebo for improving global IBS symptoms in a recent meta-analysis.[25] In addition, it is more likely to improve symptoms of bloating (odds ratio, 1.55; number needed to treat to improve symptoms in one patient, 10.1). However, it is not currently PBS approved for this indication and so is relatively expensive.

Complementary medicines

Patients often use complementary medicines, although their efficacy is frequently not proven. Research has shown some benefit with the use of enteric-coated peppermint oil, Iberogast (STW5, a proprietary herb mixture) and selected probiotics in functional GI disorders, including bloating.[26-28] These products have generally been found safe for short-term use and warrant a trial for patients with functional bloating.

Conclusion

Abdominal bloating is a relatively nonspecific term used to describe the subjective sensation of abdominal distension. Despite bloating being common, it is the most poorly understood GI symptom and may mean different things to different patients. It is important to take a thorough clinical history and perform a physical examination to ascertain and clarify the patient's symptoms and to ensure that an organic disease is excluded before attributing bloating to IBS or another functional GI disorder.

Treatment of bloating is unlikely to be uniform, given the heterogeneity of symptoms between patients. Various treatment options may be tried to tailor an effective regimen for individual patients. Treatment usually begins with dietary modification, followed by a short-term trial of pharmacological therapies. The effect of antispasmodics, prokinetics, and complementary medicines is variable and inconsistent, but short-term use is usually not associated with major side effects. MT

References

A list of references is included in the website version (www.medicinetoday.com.au) and the iPad app version of this article.

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