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REVIEW

Abdominal Bloating and Distension: What Is the Role of the Microbiota

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Abstract Most patients with irritable bowel syndrome complain of a sensation of an increase in pressure within their abdomen during the course of the day which is called bloating and, in approximately half of these individuals, this symptom is accompanied by an actual increase in abdominal girth, which is referred to as distension. The pathophysiology of these two phenomena is somewhat different and it is now recognised that a whole variety of overlapping mechanisms are involved. Some of these are potentially amenable to treatment by modification of the bacterial flora of the gut and this article reviews the evidence for this.

Keywords Irritable bowel syndrome · Bloating · Distension · Microbiome

Background

Patients with functional gastrointestinal disorders, especially irritable bowel syndrome (IBS), frequently complain of bloating and distension and it is not uncommon for them to report that these features often occur on a daily basis and, as a consequence, are especially bothersome. Another problem is that their management has always proved challenging, probably because, until recently, their pathophysiology has been poorly understood. However, the situation is now beginning to change with the recognition that a whole variety of factors may be involved and, importantly, that bloating and distension should be regarded as different but overlapping conditions. It is now suggested that the term bloating should be applied to the sensation of an increased pressure within the abdomen and that the term distension should only be used when this sensation is accompanied by an actual increase in abdominal girth. Recent research has indicated that in approximately 50% of patients reporting bloating, this sensation is accompanied by distension [1] and that there are subtle differences in the mechanisms underlying these conditions [2, 3].

Putative Causes of Bloating and Distension

Research on bloating and distension has been hampered by the lack of availability of suitable methods of investigation but this has been changed by the advent of techniques such as the gas challenge technique [4, 5], abdominal inductance plethysmography [6, 7], abdominal and diaphragmatic electromyography [8, 9], CT scanning [10], and no doubt magnetic resonance imaging will contribute in the future. The application of such methodology has resulted in the recognition that bloating tends to be associated with a phenotype characterised by increased visceral sensitivity [11], impaired gas handling [4], and diarrhoea [12], whereas distension is more often related to constipation [12], delayed gastrointestinal transit [12], weak abdominal musculature [13], and an abnormal accommodation reflex

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[8–10] where there is paradoxical contraction of diaphragmatic and abdominal muscles in response to an increase in abdominal pressure. In addition, there is evidence that in at least a proportion of patients with IBS, the bacterial flora of the gut may be disturbed [14–16] and additionally, fermentation may also contribute to symptoms [17] raising the possibility that these two factors may also contribute to both bloating and distension.

Treatment Approaches to Bloating and Distension

As a consequence of this evidence that bloating and distension differ mechanistically to some extent, it follows that the success of treatment is likely to be enhanced if the appropriate pathophysiological abnormality is targeted in a particular individual. For example, relieving constipation is more likely to improve distension whereas for a patient with bloating alone, aiming to reduce visceral hypersensitivity is a more logical strategy. Unfortunately, the situation is somewhat complicated by the fact that, at least in the UK, patients tend to describe their problem as bloating, irrespective of whether they are troubled by bloating or distension, but at least these pathophysiological observations provide a framework for a systematic approach to managing these problems.

Of the various pathophysiological mechanisms involved in bloating and distension that have been enumerated above, it seems reasonable to speculate that dysbiosis, gas handling, constipation, diarrhoea, visceral hypersensitivity, and fermentation might be amenable to modification by use of probiotics or antibiotics and there follows a discussion providing some evidence to support this view.

The Therapeutic Potential of Antibiotics and Probiotics

The notion that the microbiota of the gastrointestinal tract may be disturbed in patients with IBS has largely been prompted by two observations. First, for some patients with IBS there seems to be evidence of a low-grade inflammatory response within their gastrointestinal mucosa. Second, for others there is evidence of small intestinal bacterial over-growth (SIBO). Given that some probiotic bacteria have been shown to have a range of anti-inflammatory activity it is not surprising that their use has been advocated as a possible treatment for IBS. A relatively large number of controlled trials have been reported to date and, although their design has been rather variable, most have shown some evidence of a positive effect [18]. However, it should also be noted that different symptoms seem to respond to different probiotics but in a significant proportion of studies an improvement in subjectively reported bloating has been documented. Evidence for SIBO has come from studies using breath testing techniques after carbohydrate ingestion and, depending on the substrate used, the reported prevalence of the SIBO in IBS is somewhat variable [19]. Nevertheless, these observations have led some researchers to speculate that antibiotics, especially if they are of the non-absorbable variety, might have therapeutic potential in IBS, and the first studies used neomycin with positive results [20]. Subsequently, rifaximin has become the antibiotic of choice and there is now evidence that the use of this drug over a period of 7–14 days can reduce symptoms, including gaseousness and bloating, not only in the short term but also for a period of up to 3 months [21–23]. Obviously, the prolonged use of antibiotics to treat a condition such as IBS could not be advocated, but if a short course of a non-absorbable antibiotic is beneficial with a substantial carry over effect, then this option might well have some utility. One of the problems with any research in this area has been that, until recently, evidence of the role of bacteria in conditions such as IBS has been hampered by the fact that it could only be investigated indirectly by the use of techniques such as breath testing, or directly by culture techniques which are impeded by the fact that only a relatively small proportion of the gut microbiota can be cultured [19, 24, 25]. However, with the advent of molecular techniques, it is now possible to more accurately address this issue, and, after use of such approaches, reports are already emerging of variations in the microbiological profiles of gut bacteria in IBS [16, 26–32].

Specific Evidence of the Benefit of Individual Antibiotics or Probiotics in Bloating and Distension

Over the years, the Barcelona group have undertaken a series of elegant studies showing that compared with controls, patients with IBS have impaired handling of a gas load leading to gas trapping and the symptom of bloating [4]. This observation suggests that first, patients with bloating should avoid carbonated drinks and foods that tend to produce gas, and, second, that an attempt to alter endogenous gas production by modification of the bacterial flora is worthy of consideration, and that this could possibly be achieved by the use of an antibiotic or a probiotic. Certainly, some of the studies using rifaximin (Fig. 1) have supported this view [21–23, 33] and it is noteworthy that a reduction in bloating has been reported after use of some probiotics, for example VSL#3 [34, 35] and *Bifidobacterium infantis 35624* [36], although whether this is a result of a reduction of endogenous gas-forming organisms has to be speculative and an alternative explanation might be an effect on visceral sensation.

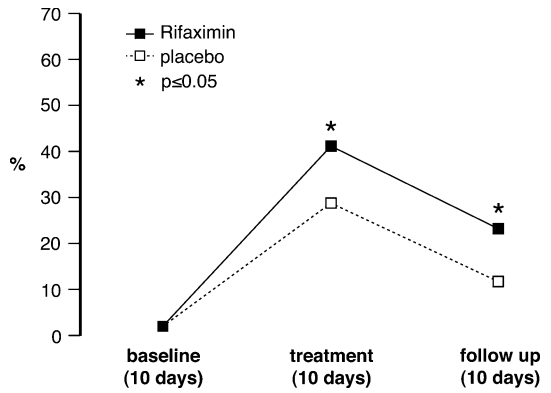

Fig. 1 A comparison of the effect of rifaximin or placebo on subjective global relief of symptoms in patients with abdominal bloating and flatulence. Taken from Ref. [22]

Visceral hypersensitivity is one of the most well described pathophysiological abnormalities in IBS [37, 38] and it has even been suggested that it might be a biological marker for the condition [39]. Consequently, it is frequently regarded as a potential target for treatment, especially by the pharmaceutical industry. The mechanism by which sensitisation is induced is not clear but it is of note that many patients date the onset of their IBS to an episode of gastroenteritis [40, 41]. It has been suggested that this could lead to sensitisation of the gastrointestinal mucosa as a result of persisting, low grade, inflammation or, alternatively, by a change in the gastrointestinal flora. It is, therefore, not surprising that it has been suggested that probiotics might have utility in reducing visceral sensitivity. To our knowledge there have, so far, been no studies of this in humans but there are promising data in animals [42–44] indicating that it is certainly worthy of further exploration.

Constipation [1] and delayed gastrointestinal transit [12] are associated with distension and it seems reasonable to suppose that improving constipation and hastening transit might lead to improvement of this problem. Consequently, it is of interest that the Barcelona group have shown that accelerating the transit of gas through the gut by administration of a prokinetic agent such as neostigmine can reduce girth [45]. Thus, if transit could be hastened by administration of a probiotic this could be an approach that might have potential in relation to reduction of abdominal distension. In physiological studies DN-173-010 has been shown to accelerate gastrointestinal transit [46–49] and, in clinical trials, to reduce the subjective reporting of bloating [37]. Therefore, this organism should, theoretically, have the potential to improve distension and this question has recently been addressed in a study using abdominal inductance plethysmography to objectively measure abdominal girth in patients with constipation-predominant IBS. Compared with a matching placebo, the active probiotic, delivered as a yogurt twice daily, significantly reduced abdominal girth (Fig. 2), and this was accompanied by an acceleration in both small and large bowel transit and an improvement in symptoms [50]. It is also noteworthy that in an unrelated study, the frequency of the migrating motor complex was found to decrease in patients with IBS in whom the presence of SIBO was suggested by an abnormal lactulose breath test [51]. Interestingly, motility seemed to be enhanced once this overgrowth had been eradicated [51].

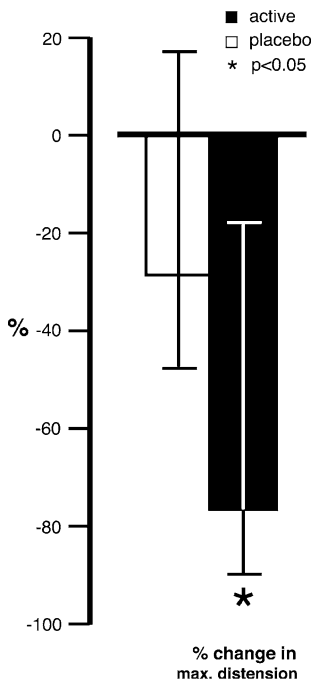

Fig. 2 A comparison of the effect of *bifidobacterium lactis* DN-173 010 or placebo on the percentage reduction in maximum distension (maximum distension post treatment − maximum distension at baseline/maximum distension at baseline × 100) in patients with irritable bowel syndrome. Taken from Ref. [50]

Conclusion

It seems that some probiotics and antibiotics may have a role in treating bloating and distension and this is possibly as a result of an effect on some of the mechanisms involved in the pathophysiology of these two common features of functional bowel disorders. Furthermore, it could be expected that as our understanding of the gastrointestinal microbiota and bloating and distension improves, even better control of these enigmatic symptoms might be forthcoming.

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