Review article

Small Intestinal Bacterial Overgrowth (SIBO) and cancer. A comprehensive review of emerging connections

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ABSTRACT

Small Intestinal Bacterial Overgrowth (SIBO) is increasingly recognized in oncology. It often complicates treatment, reduces quality of life, and may contribute to carcinogenesis through chronic inflammation. Diagnostic breath tests, widely used for SIBO, show promise in early detection of colorectal polyps and cancer. Current therapies (antibiotics, diet, probiotics) provide partial relief, but data in oncology remain limited. Recognizing and managing SIBO in cancer care may improve outcomes and requires further research.

Key words: SIBO, cancer, oncology, review

INTRODUCTION

In recent years, our understanding of the intricate connections between the human microbiome and numerous diseases has advanced at an unprecedented pace. In this paper, we aim to summarize the current state of knowledge regarding the relationship between Small Intestinal Bacterial Overgrowth (SIBO) and malignant neoplasms.

Modern medicine is intensively seeking new avenues in the fight against diseases of civilization, particularly cancer, which remains one of the leading causes of mortality worldwide. Concurrently, there is a growing awareness of the crucial role the gut microbiome plays in maintaining health and its impact on the development of various pathologies.

For the purpose of this review, a detailed analysis of scientific literature available in PubMed and Google Scholar was conducted using the search query "(SIBO) AND (cancer)". This search identified 78 publications, which were further evaluated; ultimately, 55 studies were included to provide a comprehensive overview of the subject.

SIBO is a condition characterized by an excessive proliferation of bacteria in the small intestine, which should physiologically remain relatively sterile. The small intestine normally contains far fewer microorganisms than the large intestine, and its proper functioning depends on maintaining this delicate condition. Overgrowth of bacteria – often species typical of the colon – can lead to a range of health problems stemming from impaired digestion and nutrient absorption, as well as the production of harmful metabolites [1]. The epidemiology of SIBO varies depending on the population studied, but it is estimated to affect up to 20% of the general population [2]. The true prevalence may be underestimated due to diagnostic challenges and often non-specific symptoms. In a 2021 study, among 1461 patients undergoing breath tests, 33% tested positive for SIBO [3]. Importantly, the prevalence of SIBO increases significantly in certain high-risk groups, including:

- Irritable Bowel Syndrome (IBS): SIBO is estimated to occur in as many as 80% of patients with IBS, suggesting a strong link between these two disorders [4].
- Diabetes: SIBO is diagnosed much more frequently in diabetic patients than in the general population. SIBO is present in 29% of diabetic patients (types 1 and 2), with a risk nearly 3 times higher than in non-diabetics [5].
- Chronic pancreatitis: the prevalence of SIBO in patients with chronic pancreatitis was 38.6% in one meta-analysis [6].
- Celiac disease, Parkinson's disease, and patients taking proton pump inhibitors (PPIs): these are also groups at increased risk of SIBO [7–9].

While SIBO is commonly associated with digestive ailments such as bloating, abdominal pain, and diarrhea, there is a growing body of evidence suggesting potential connections to more serious conditions, including cancer. Understanding the possible interrelationships between SIBO and cancer could open new perspectives in oncological prevention, diagnosis, and therapy, emphasizing the importance of a holistic approach to gut health.

MANAGEMENT OF SMALL INTESTINAL BACTERIAL OVERGROWTH IN ONCOLOGY PATIENTS

Given the recognized interplay between SIBO and malignancy, an initial practical consideration is how to manage SIBO in patients undergoing cancer treatment. Standard management of SIBO typically involves antibiotic therapy [10]. Additional strategies proposed in the literature include dietary modifications, probiotics, fecal microbiota transplantation (FMT), surgical interventions, prokinetic agents, postbiotics, physical exercise, and herbal medicines [11–14]. However, there is a noticeable lack of studies specifically addressing the treatment of SIBO in oncology patients. As a result, current therapeutic approaches for this group are generally based on guidelines developed for the general population. While this extrapolation is reasonable in the absence of targeted data, further research is needed to evaluate the safety and effectiveness of SIBO treatment in the unique clinical context of cancer patients. Nevertheless, a few studies have examined SIBO treatments in oncology patient populations. For instance, the effectiveness of rifaximin in treating SIBO among postoperative colorectal cancer patients was investigated in a small study involving 18 individuals with a positive glucose hydrogen breath test (GHBT) [15]. After a 10-day course of rifaximin (1200 mg daily), 6 patients (33.3%) converted to a negative GHBT, indicating partial eradication of bacterial overgrowth. Treatment was also associated with a reduction in gastrointestinal symptoms. According to the 2020 ACG clinical guidelines [10], recommended antibiotics for SIBO include rifaximin, metronidazole, ciprofloxacin, amoxicillin-clavulanate, norfloxacin, tetracycline, doxycycline, trimethoprim-sulfamethoxazole, and neomycin. Another source suggests that clarithromycin and vancomycin can be effective as well [16]. Antibiotic therapy, however, is associated with several challenges, including high recurrence rates, variable patient responses, and a lack of standardized treatment durations or dosing regimens [10, 16]. Thus, guidelines emphasize the need for individualized treatment decisions. Dietary intervention is another avenue for managing SIBO in cancer patients. Borre et al. [17] evaluated the effectiveness of personalized dietary guidance in patients with persistent gastrointestinal symptoms following treatment for pelvic organ cancers. Among 88 participants, 58 were diagnosed with SIBO, and standard pharmacological treatment had proven insufficient. Patients received individualized nutritional recommendations, including a low-fat diet, a moderately low fermentable oligosaccharides, disaccharides, monosaccharides and polyols (FODMAP) diet, adjustments to fiber intake, a gluten-free diet, and other tailored advice. Significant improvements in SIBO-related symptoms were observed. These findings suggest that in oncological patients with SIBO, targeted dietary intervention can complement pharmacological therapy, particularly in cases resistant to conventional treatment. Notably, the ACG clinical guidelines [10] also mention the low-FODMAP diet as a potential therapeutic approach for SIBO, though they underscore the limited evidence for its effectiveness. Probiotic therapy has likewise been studied. In a double-blind, placebo-controlled trial, the effect of probiotics on SIBO was assessed in 126 cancer patients (with gastric or colorectal cancer) who had a positive GHBT [18]. Participants received a 4-week course of a *Bifidobacterium* triple viable capsule. After treatment, only 19% of patients in the probiotic group remained GHBT-positive, compared to 74.6% in the placebo group. Moreover, probiotic therapy significantly reduced clinical symptoms. It should be noted that evidence on probiotic use in non-oncological SIBO patients is conflicting and inconclusive, with some studies suggesting symptom relief while others indicate potential harm [10, 12]. In summary, current management of SIBO in cancer patients relies on standard therapies adapted from the general population, and dedicated research in oncology is limited. Early studies indicate that antibiotics (such as rifaximin), tailored diets, and probiotics can alleviate SIBO and its symptoms in cancer patients to some extent. This underscores the need for further studies to establish optimal, safe treatment protocols in this unique patient group. Beyond treatment considerations, another emerging aspect of the SIBO–cancer connection lies in diagnostics. In particular, breath tests used for SIBO diagnosis may have potential applications in cancer detection, as discussed in the next section.

METHANE AND HYDROGEN BREATH TESTS IN ONCOLOGICAL DIAGNOSTICS

The use of hydrogen and methane breath tests in oncology is an area of growing scientific interest. Although these non-invasive tests are commonly used to diagnose SIBO, emerging evidence suggests they may also serve as valuable tools in the detection of cancer or precancerous conditions. In one single-center retrospective cohort study, the diagnostic value of combined methane-hydrogen breath testing (MHBT) and fecal microbiota profiling via qPCR was evaluated for detecting colorectal polyps [19]. Among 87 patients with polyps and 109 controls, the combined analysis of MHBT results and the abundance of selected bacterial taxa yielded an area under the curve (AUC) of 0.831, outperforming the use of methane or hydrogen levels alone. When MHBT was paired with microbiota profiling, it provided a non-invasive, stratified screening approach for the early detection of colorectal polyps prior to colonoscopy. Moreover, the authors suggested that MHBT could act as an early warning indicator of malignant transformation risk, potentially preceding detectable abnormalities in conventional tumor markers such as carcinoembryonic antigen (CEA). However, further research is warranted to validate this finding. Similar results were reported in another study, where lactulose breath test (LBT) results were significantly associated with the presence of colorectal polyps [20]. In most studies, analyzing hydrogen and methane values together provided better diagnostic accuracy than measuring either gas alone [19–21]. When comparing methane breath testing (MBT) and hydrogen breath testing (HBT) individually for colorectal polyp detection, all available sources indicated the superiority of MBT over HBT [19–22]. Notably, one study specifically evaluated MBT for colorectal cancer detection, reporting an AUC of 0.7104 for methane concentration at the 60-minute mark in distinguishing colorectal cancer patients from those with functional bowel disorders [21]. Breath testing may also predict certain complications in oncology patients. In a 3-year prospective cohort study, researchers examined the association between SIBO and overt hepatic encephalopathy (HE) in patients with liver cirrhosis [23]. Of 107 cirrhotic patients, 77 (72.0%) had hepatocellular carcinoma (HCC). Multivariate analysis identified methane-positive SIBO (M-SIBO) as an independent predictor of overt HE. These findings suggest that the presence of M-SIBO may serve as a clinically relevant predictor of overt HE in cirrhotic patients, including those with HCC. Another innovative application of breath testing has been explored in patients with head and neck squamous cell carcinoma (HNSCC) [24]. In that study, the ratio of exhaled CH_4 to H_2 was significantly higher in cancer patients and increased with tumor stage. Unlike standard SIBO breath tests, the protocol in this study did not follow North American Consensus guidelines [25] – most notably, no fermentable substrate was administered before breath collection. It should be noted that due to the limited number of studies, the summary above includes 2 preprint reports (Zhang et al. 2020 [22] and Chen et al. 2024 [21]) that have not undergone peer review; their findings should therefore be interpreted with caution. Several older studies from the 1970s–1990s also investigated breath testing in oncology, but they were excluded from this review due to their age and potential lack of relevance to current practices. In summary, while traditionally used for SIBO diagnosis, breath tests (measuring hydrogen and methane) show promise as non-invasive indicators in oncology – especially for colorectal neoplasia – when combined with microbiome analysis. These tests might provide early warning signs of malignancy risk, although further validation and standardization are needed. Beyond diagnostics, it is also critical to consider how cancer therapies themselves can predispose patients to SIBO. The next section examines SIBO as a complication of cancer treatment.

SMALL INTESTINAL BACTERIAL OVERGROWTH AS A COMPLICATION OF CANCER TREATMENT

According to the 2022 *Cancer Atlas*, 54 mln cancer cases were recorded worldwide in the past 5 years. In 2018 alone, 3.5 mln new cases of gastrointestinal cancer were registered [26]. The World Health Organization (WHO) predicts that the global number of new cancer cases will increase to 35 mln per year by 2050 – a 77% increase compared to 2022. With the growing number of patients diagnosed with cancer, it is increasingly important to maintain or restore their quality of life, which can decline dramatically as the disease progresses and is treated [27]. It is estimated that 20–25% of patients undergoing cancer treatment experience unpleasant gastrointestinal side effects as a result of therapy [28]. Common symptoms include chronic motility disorders of the intestines, dysphagia, nausea, gastroesophageal reflux, bloating, diarrhea, and urgency or increased frequency of defecation [28]. These issues are often considered inevitable consequences of chemotherapy, radiotherapy, or surgery. In reality, some of these symptoms can be attributed to coexisting medical conditions that are not routinely diagnosed because the focus is on the primary disease (cancer), or because patients and providers may assume these issues are an unavoidable part of cancer treatment [28]. Given the many possible causes of gastrointestinal complaints in cancer patients, an integrated, multifaceted approach to evaluation and management is necessary. Notably, SIBO is one of the most common diagnoses in cancer patients with chronic gastrointestinal symptoms, accounting for roughly 38% of such cases [28]. Other contributory factors include bile acid malabsorption (BAM, in about 25% of patients) and exocrine pancreatic insufficiency (EPI, ~5% of patients) [28]. The prospective FOCCUS (Focusing on Cancers Chemotherapys' Untreated Symptoms) study underscored the importance of investigating gastrointestinal symptoms before, during, and after chemotherapy in patients with gastrointestinal malignancies [29]. That study found that nonspecific GI (gastrointestinal) symptoms in these patients were often due to treatable conditions: SIBO, BAM, or even unrelated issues like urinary tract infection. In FOCCUS, 54% of patients had breath test results suggestive of SIBO (using a glucose hydrogen/methane breath test) [29]. All of these conditions are potentially curable, and their diagnosis and treatment are crucial for improving the quality of life of cancer patients. SIBO itself may be asymptomatic or may manifest with abdominal pain, bloating, excessive gas, distension, flatulence, and diarrhea [30]. In patients with underlying gastrointestinal cancers, SIBO can exacerbate the digestive symptoms of the primary disease [15]. However, one study found no significant correlation between symptom severity and the histopathological changes in the GI tract caused by chemotherapy [29]. The long-term effects of untreated SIBO include malnutrition, fat malabsorption, and deficiencies of fat-soluble vitamins (A, D, E) as well as vitamin B_{12} and iron, leading to weight loss [28, 31]. Among cancer patients, SIBO has been associated with poorer treatment outcomes [15]. Certain cancer treatments predispose patients to developing SIBO. For example, patients who undergo partial or total gastrectomy (stomach removal) to treat upper gastrointestinal tumors often experience long-term consequences of surgery, including malnutrition, unintended weight loss, and changes in the intestinal microflora. These outcomes are direct consequences of surgery that disrupts normal digestion and absorption by altering the GI anatomy. According to a study by Pérez Aisa et al., SIBO was identified in 61.6% of patients after gastrectomy, although no significant association between SIBO and malnutrition was found in that group – pointing to the surgery itself as the main cause of malnutrition [31]. Similarly, a prospective study of patients post-gastrectomy or esophagectomy found SIBO in 37.8% within 6 months after surgery in those with malabsorption symptoms. No clear correlation between SIBO and malnutrition emerged, but after a 7-day course of rifaximin, most patients experienced symptom improvement [32]. In another investigation, patients after partial gastrectomy who had gastrointestinal symptoms showed significantly higher counts of small-intestinal bacteria grown under anaerobic conditions (median 10^8 CFU/mL) compared to non-operated controls (median $10^{4.5}$ CFU/mL) [33]. Interestingly, asymptomatic post-gastrectomy patients had bacterial counts (median 10^9 CFU/mL) similar to those of symptomatic patients. (No qualitative microbiota analysis was performed in that study.) In a separate cohort of post-gastrectomy and post-esophagectomy patients, 73.5% had SIBO (regardless of the presence of SIBO-related symptoms). The authors suggested that because lactulose and glucose breath tests have limited sensitivity, the true prevalence of SIBO in such patients might be even higher than 73.5% [34]. Relatively little research has focused on understanding why intestinal complications like SIBO occur after colorectal cancer surgery [35]. Patients who have undergone right-sided hemicolectomy for colon cancer commonly experience chronic loose stools (classified as type 6–7 on the Bristol Stool Scale). One study showed that SIBO occurs in 73% of such cases [35]. The exact pathophysiology is unknown, but it is thought that resection of the ileocecal valve allows colonic bacteria to reflux into the small intestine, promoting SIBO. Interestingly, in these patients the loose stools were not directly linked to SIBO; instead, a strong correlation with type 1 BAM (bile acid malabsorption due to ileal dysfunction) was observed, suggesting that BAM – rather than SIBO – was the primary cause of diarrhea in this context [35]. More broadly, the prevalence of SIBO in postoperative colorectal cancer patients has been reported at 41.9%, compared to only 6.7% in a healthy control group. Cancer patients with SIBO tended to have more severe GI symptoms than those without SIBO. After 10 days of rifaximin therapy, gastrointestinal symptoms (particularly diarrhea) improved significantly, and 33.3% of SIBO-positive patients had a negative breath test (indicating SIBO eradication) post-treatment [15]. In summary, SIBO is frequently observed as a complication in cancer patients – especially in those who have undergone major GI surgery – and it can substantially contribute to gastrointestinal symptoms and nutritional deficiencies during survivorship. The good news is that conditions like SIBO, BAM, and EPI are treatable, and addressing them can markedly improve patients' quality of life. Having explored SIBO as a consequence of cancer treatment, a related question is whether SIBO might also influence cancer development. The following section summarizes current knowledge on the potential impact of SIBO on carcinogenesis.

IMPACT OF SMALL INTESTINAL BACTERIAL OVERGROWTH ON CARCINOGENESIS

The role of the gut microbiota in the development and progression of various diseases is increasingly recognized, even in conditions that at first glance seem unrelated to the gut microbiome. SIBO has the potential to influence the development of diseases affecting the gastrointestinal, immune, cardiovascular, endocrine, renal, dermatologic, and nervous systems, as well as certain psychiatric disorders [28, 36, 37]. In this section, we focus on the current knowledge regarding the impact of SIBO on carcinogenesis. Some studies indicate a possible influence of SIBO on the development of pancreatic cancer, cholangiocarcinoma, and hepatocellular carcinoma (HCC) [38, 39]. Although a healthy pancreas is normally sterile, bacterial components such as lipopolysaccharide (LPS) can trigger sterile inflammation in the pancreas, potentially contributing to carcinogenesis [40]. Cases have been documented in which bacteria migrate from the duodenum to the pancreas [41], highlighting their potential role in pancreatic cancer development [42]. Ma et al. (2019) offered further mechanistic insight by examining the link between SIBO and Toll-like receptor 4 (TLR-4) in pancreatic and biliary cancers [39]. Their study found a significant positive correlation between the presence of SIBO and TLR-4 expression in tumor tissue, reporting:

The mean percentage of TLR-4-positive cells in pancreatic carcinoma tissues of patients with SIBO was 70.6%, which was significantly higher than the 61.5% in tissues without SIBO; the difference was statistically significant ($\chi^2 = 7.177$, $p < 0.05$) [39].

Toll-like receptors are a family of pattern-recognition receptors that play a key role in immune defense by recognizing pathogen-associated molecular patterns (PAMPs) [43]. When TLR-4 on cancer cells is activated by bacterial LPS, it triggers the NF-κB signaling pathway, leading to increased production of pro-inflammatory cytokines [43]. TLR-4 activation has also been implicated in the proliferation of cancer cells [39]. SIBO has also been linked to non-alcoholic fatty liver disease (NAFLD), which can progress to cirrhosis and HCC. A significant portion of blood is delivered to the liver through the portal vein, which drains the intestines. In the context of SIBO, an overgrowth of gut flora combined with increased intestinal permeability means that large amounts of bacterial metabolites and even live bacteria can reach the liver [44]. The primary mechanism thought to drive liver injury in this scenario involves TLR activation and the production of pro-inflammatory mediators, leading to chronic inflammation and disease progression [44, 45]. Another contributing factor in SIBO is a reduction in short-chain fatty acids (SCFAs) due to altered gut microbial composition; SCFAs have anti-inflammatory properties, and their deficiency may further increase the risk of developing NAFLD and subsequent HCC [45]. Overall, the impact of SIBO on cancer development is not yet fully clear. The studies discussed above suggest that SIBO-induced changes in the gut microbiome and immune environment could contribute to malignancy in certain settings, but the number of direct investigations on this topic is still limited. More research is needed to conclusively determine how and to what extent SIBO influences carcinogenesis. Given the potential importance of SIBO in both cancer patients and possibly in cancer development, accurate diagnosis of SIBO is critical. The final section of this review will outline the methods available for diagnosing SIBO and the challenges associated with them.

METHODS OF DIAGNOSING SIBO

Diagnosing SIBO is challenging, which in turn complicates its management. The condition's true prevalence remains unknown, in large part because making the diagnosis requires specialized tests that lack standardized indications, uniform methodology, and clear interpretation criteria [25]. Moreover, the clinical presentation of SIBO is not specific; it often includes gastrointestinal symptoms common to many other disorders, and in some cases the symptoms are mild or absent. These factors frequently delay diagnosis and treatment. SIBO symptoms are highly non-specific and primarily affect the gastrointestinal tract, though some publications suggest potential manifestations in other systems (including neurological or psychiatric symptoms). It is also important to note that SIBO can be entirely asymptomatic. The most commonly reported symptoms are bloating, a feeling of fullness, diarrhea, and alternating diarrhea and constipation [46]. All these symptoms can vary in severity and may wax and wane over time. They often overlap with symptoms of concurrent diseases or even occur occasionally in healthy individuals. As a result, a long interval often passes between symptom onset and the first medical evaluation, significantly delaying the initiation of appropriate therapy. As SIBO persists, more pronounced effects can appear: unintentional weight loss, inability to gain weight, steatorrhea (fat malabsorption), and deficiencies in fat-soluble vitamins A, D, and E, as well as vitamin B_{12} and iron [47, 48]. These nutrient deficiencies can lead to secondary problems – for example, iron or B_{12} deficiency may result in anemia, and chronic vitamin D deficiency can cause calcium metabolism disturbances. Interestingly, some studies suggest that an increased proliferation of bacteria in SIBO can lead to the production of vitamin K and folate, while simultaneously competing for vitamin B_{12}, which may lead to its deficiency [10]. SIBO has also been associated with non-gastrointestinal symptoms such as concentration difficulties, chronic fatigue, brain fog, anxiety, and depression [46, 49, 50]. More research is needed to confirm these associations. Crucially, SIBO cannot be diagnosed based on clinical symptoms alone; specialized testing – either non-invasive or invasive – is required. Currently, the diagnostic gold standard for SIBO is culture of a small intestine aspirate obtained endoscopically. Despite being the gold standard, this method has many limitations and is increasingly being supplanted by breath testing due to greater availability and patient comfort [48]. The main drawbacks of aspirate culture are its invasiveness, high cost, time-consuming nature, and lack of standardization in sample collection. Aseptic technique is critical when obtaining the sample [49]. Consequently, the procedure requires experienced clinicians and a capable microbiology laboratory. Otherwise, contamination can easily occur, leading to false-positive results from oropharyngeal bacteria. One study showed that when using a single-lumen endoscopic catheter, contamination of duodenal aspirates occurred in 19.6% of cases [51]. False negatives are also possible, due to the patchy distribution of bacteria in the small intestine and the inability to culture certain intestinal microbes using standard techniques [52]. Currently, the threshold for diagnosing SIBO via jejunal aspirate culture is $\geq 10^5$ CFU/mL of bacteria; for duodenal aspirates, some guidelines suggest a lower cutoff of $\geq 10^3$ CFU/mL [48]. Given the multiple potential points of error, this method is not routinely used in clinical practice. Noninvasive breath tests are now commonly used to diagnose SIBO, and the number of breath tests performed is growing each year. These tests are based on measuring the concentrations of hydrogen (H_2) and methane (CH_4) in exhaled air after the ingestion of a test substrate. Intestinal bacteria produce H_2 and CH_4 through fermentation, and these gases diffuse into the bloodstream and are exhaled via the lungs. Breath testing has several advantages: it is non-invasive, less expensive, and more accessible than aspirate culture. However, there is considerable variability in test preparation, execution, and interpretation. For example, North American consensus guidelines state that it is not necessary to discontinue proton pump inhibitors (PPIs) before a breath test, whereas other sources recommend stopping PPIs about one week prior [25, 46]. There is no clear evidence regarding the effects of prebiotics or probiotics on test results. It is generally agreed, however, that antibiotics should be avoided for 4 weeks before testing [25, 46]. Glucose and lactulose are the two most commonly used substrates for SIBO breath tests. Each has its advantages and limitations. Glucose is rapidly absorbed in the proximal small intestine, which means a glucose breath test might miss bacterial overgrowth confined to the distal ileum [53]. Lactulose, in contrast, is not absorbed in the gut; it travels through to the colon, where it will eventually be fermented by bacteria. However, because lactulose accelerates intestinal transit and reaches the colon relatively quickly, early fermentation in the colon can cause a rise in breath hydrogen that mimics SIBO – resulting in a false-positive test. Such false positives can lead to unnecessary antibiotic treatment and contribute to antibiotic resistance. Many studies have reported a wide range of sensitivities and specificities for both types of breath tests: for glucose, sensitivity ranges from about 20% to 93% and specificity from 30% to 86%; for lactulose, sensitivity ranges from ~31% to 68% and specificity from 44% to 100% [25]. The typical doses used are 75 g for glucose (similar to an oral glucose tolerance test) and 10 g for lactulose (higher doses of lactulose can excessively accelerate transit and increase false positives) [25]. Ideally, breath test devices should measure both hydrogen and methane simultaneously, since methanogenic bacteria consume hydrogen to produce CH_4 – meaning that high methane production can mask the presence of hydrogen. Not all currently available portable breath analyzers have dual-gas measurement capability; improving this feature could enhance diagnostic accuracy. It is also beneficial for breath tests to measure a marker of alveolar air (such as CO_2) to confirm that breath samples are properly collected (undiluted by room air) [25]. According to the North American consensus, a rise in hydrogen of ≥20 ppm above baseline within 90 min (or a rise in methane of ≥10 ppm) is considered a positive SIBO result [25]. European guidelines suggest a lower hydrogen threshold (an increase of ~10–12 ppm over baseline) for a positive test [53]. Researchers are also investigating modern methods to improve SIBO detection. One novel approach is the endoscopically assisted glucose breath test (EAGBT), where glucose is delivered directly into the small intestine during endoscopy for patients who have a negative standard (oral) breath test [54]. Another innovation is an ingestible electronic capsule capable of sensing gas levels in vivo as it passes through the GI tract; such a capsule can directly measure hydrogen and carbon dioxide production from carbohydrate fermentation in the small intestine [55]. Additionally, molecular techniques like polymerase chain reaction (PCR) analysis of 16S ribosomal RNA from intestinal samples are being explored as more sensitive alternatives to culture for identifying bacteria [47]. All of these innovative approaches require further clinical research to assess their utility in routine SIBO diagnosis. For now, they remain research tools or methods to consider in complex cases where standard tests yield inconclusive results.

CONCLUSION

SIBO has emerged as a multidimensional concern in oncology, with relevant implications for patient care and outcomes. It frequently complicates the course of cancer treatment by exacerbating gastrointestinal symptoms and nutritional deficiencies, thereby diminishing quality of life. Preliminary evidence also hints at a role for SIBO in promoting certain cancers through chronic inflammation and immune modulation, while the breath tests used to diagnose SIBO might have ancillary utility in cancer detection. These emerging connections underscore the importance of maintaining a high index of suspicion for SIBO in cancer patients and managing it appropriately. Ultimately, integrating gastroenterological insights – like the diagnosis and treatment of SIBO – into oncologic care has the potential to improve patient well-being and possibly even influence disease trajectories. As current data are limited, further research is crucial to fully elucidate the links between SIBO and cancer and to guide evidence-based practice at this intersection.

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