

The role of virtual reality in managing inflammatory bowel disease: a novel approach to bridging mental and physical health

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Abstract

Inflammatory bowel disease (IBD), encompassing Crohn's disease and ulcerative colitis, is characterized by symptoms such as fatigue, abdominal pain, and diarrhoea, which may persist even when inflammation is controlled. These symptoms are further exacerbated by psychological stress, which may complicate disease management that involves the gut–brain axis—a bidirectional communication pathway linking the gastrointestinal system and the central nervous system. While stress, anxiety, and depression are prevalent among patients with IBD, access to comprehensive mental health care is often limited, particularly in rural and underserved areas. Virtual reality (VR) has emerged as a promising tool in managing psychological comorbidities and enhancing the overall care of patients with IBD.

The integration of VR in IBD care offers a novel, accessible approach to addressing both physical and mental health challenges, potentially improving the quality of life and clinical outcomes for IBD patients. Further research is warranted to evaluate the long-term benefits and broader applicability of VR-based interventions in diverse patient populations.

Keywords: virtual reality; inflammatory bowel disease; mental health; crohn's disease; ulcerative colitis; gut-brain axis.

Introduction

Inflammatory bowel disease (IBD) such as Crohn's disease (CD) and ulcerative colitis (UC) is associated with a high prevalence of fatigue, diarrhoea, urgency, and abdominal pain.^{1–3} However, symptoms can persist to some degree even when IBD is in remission.^{2–4} Multiple studies have reported a poor correlation between active symptoms and active disease, especially in CD.^{5–7} There are many potential causes for gastrointestinal symptoms in those with IBD when their disease is inactive. For example, patients with Crohn's disease may have structural causes for non-inflammation-related symptoms, such as fibrostenosing strictures, post-intestinal resection loss of the ileal brake, or rapid transit. In addition, there is a strong correlation between a high perception of stress and active symptoms, but stress has not been confirmed to activate inflammation.^{6,8} It is likely that the pathogenesis of stress-driven symptoms is through the gut–brain axis, an intricate bidirectional communication system where neural signals, hormonal signals, immune modulators, immune cell trafficking, and microbial signatures are shared between the gastrointestinal tract and the autonomic and central nervous systems.⁹

Mental health in IBD

Stress is common in the general population, and patients with IBD have the usual stressors that unaffected individuals have, including those related to family life, work, and finances.¹ In fact, stress regarding their disease is lower on the list of common stressors for patients with IBD.¹ Stress that is prolonged or ineffectively addressed can promote depression or anxiety. Indeed, the increased rate of depression and anxiety disorders in IBD is approximately 2-fold compared to people without IBD,^{10–12} and those with active disease have been reported to experience higher rates of anxiety compared to those in remission.¹¹ Moreover, in a study of 405 IBD patients, those without baseline anxiety exhibited a 6-fold higher rate of developing anxiety after their diagnosis (hazard ratio [HR], 5.77; 95% CI, 1.89–17.7).¹³ This relationship appears bidirectional. Those with underlying depression or anxiety experience poorer outcomes, including excess health-care utilization, hospitalization, surgeries, and decreased medication adherence.^{14–18} In CD specifically, anxiety and depression were associated with a 28% higher likelihood of requiring surgery in a cohort of 5400 patients.¹⁹ Patients in remission but with high anxiety had an increased need for

glucocorticoid prescriptions, higher rates of flare-ups, and escalation of therapy (HR, 1.82; 95% CI, 1.19-2.80).¹³ These findings underscore the importance of addressing mental health as an integral component of IBD management.

Further evidence of the brain–gut axis’s role comes from clinical interventions targeting the gut microbiome. Significant improvements were observed in symptoms of depression, anxiety, and obsessive-compulsive disorder following faecal microbiota transplant (FMT).²⁰ This suggests that altering gut microbiota can improve mental health, reinforcing the dynamic interplay between gut physiology and psychological well-being.

Hence, the optimal management of persons with IBD is best considered holistic, delivered by a team of psychologists, psychiatrists, social workers, and dietitians in concert with gastroenterologists and gastrointestinal surgeons.^{9,14,21,22} Providing mental health stewardship and care has been shown to reduce healthcare utilization, and enhance outcomes for IBD-related concerns.²³ However, multiple barriers exist that limit accessibility, including lack of nearby mental health providers, cost, long wait times, societal stigma, and failure to recognize a psychological disorder.²⁴ Other models have been introduced to help address these barriers, including digital therapeutics such as virtual reality (VR).

The role of VR in IBD

VR is a computer-generated simulation of a 3D environment. Devices are usually in the form of a headset and allow the user to engage with their environment to create an immersive experience.²⁵ There are several proposed mechanisms for how VR has been effective in treating multiple medical conditions. In pain disorders, stimulation of the visual cortex while engaging auditory and proprioceptive senses has been thought to distract the user from processing painful stimuli. Moreover,

VR promotes an illusion of time acceleration, as users have developed a shortened perception of pain episodes. In a study of 9 subjects, VR was shown to reduce pain-related brain activity in the insula and thalamus similar to opioids, and the combination of opioids with VR had a greater reduction in reports of pain than either alone.²⁶ The use of VR can also promote the development of adaptive cognitive regulation in disorders involving pain,^{27,28} phobias,²⁹ and anxiety.³⁰ In gastroenterology, VR has been studied in disorders of gut–brain interaction (DGBIs), diseases characterized by aberrancies in the bidirectional gut–brain axis,³¹ and a home-based VR program utilizing cognitive behavioural therapy (CBT) was found to be positively received in 15 patients with irritable bowel syndrome (IBS).³² Additionally, an initial qualitative study in patients with anxiety and depression found that this type of program was effective, feasible, acceptable, and safe for administering CBT.³³

Analogous to the use of VR support in DGBIs, there is a growing interest in its use in IBD. In IBD, it is essential to consider the disease holistically, recognizing the connections within the brain–gut axis remain relevant in this context. Various proposed interactions exist between gut inflammation—including genetic predisposition, pro-inflammatory cytokines from peritoneal macrophages, and alterations in the gut microbiome—and changes in brain morphology, such as the induction of pro-inflammatory cytokines.^{10,24} These interactions also modify vagal nerve signalling, characterized by increased afferent signalling, and impaired efferent pathways, which can dysregulate gut homeostasis and result in symptom exacerbation. **Figure 1** illustrates a proposed framework by illustrating the interplay between mental health and IBD biochemistry.²⁴ This perspective underscores the importance of considering both physiological and psychological factors.

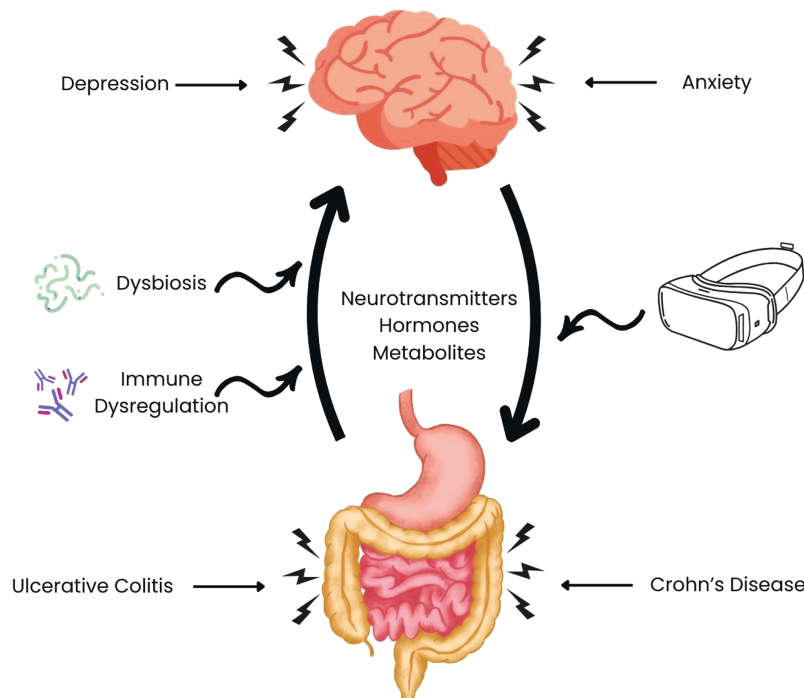


Figure 1. Illustration of a proposed framework governing the interplay between mental health and IBD biology, highlighting how gut inflammation can influence brain function and vice versa.

Digital, self-administered CBT programs can overcome barriers to mental healthcare—such as workforce shortages, costs, and social stigma—by ensuring evidence-based therapy is accessible to all, especially in rural areas lacking professionals; offering privacy and convenience by allowing patients to engage from home; being affordable compared to expensive therapist-led programs; and fitting into patients' schedules, reducing economic impact from missed work.³⁴ By leveraging technology, VR may address social determinants of health and provide a scalable solution to improve quality of life and reduce anxiety in patients with IBD. Multiple studies have thus investigated how VR may be utilized in patients with IBD.

VR during infusions

In a pilot study of 14 patients with IBD (57% Crohn's disease (CD), 43% UC) at a single centre, a VR headset was used during a routine infusion clinic appointment which included immersive options such as guided meditations and deep-sea diving.³⁵ Pain and anxiety were measured before and after the appointment, and feasibility was qualitatively assessed. The authors found that 1 session of VR in this setting did not result in significant change in anxiety or pain scores, however, participants overall reported positive experiences (7.79 out of 9) and 71% reported they would like to use VR during future appointments. The majority of participants found that VR made the infusion experience feel faster (86%) and 3 individuals forgot they were in the infusion centre.³⁵ Nevertheless, more studies are needed with a larger population undergoing multiple VR sessions in this setting to evaluate for quantifiable changes in mental health scores.

In a randomized, controlled trial at a single centre, a total of 90 patients treated with vedolizumab infusions were randomized into a VR immersion group or routine management group.³⁶ During their routinely scheduled infusion appointment, the VR group underwent a 15 min VR session focused on "gut healing," while the control group did not proceed with any VR intervention. This VR application immersed the participants within the gastrointestinal tract and allowed them to experience the mechanism of action of vedolizumab, specifically being able to block lymphocytes from infiltrating the digestive system. Between the 2 arms of this study, there was a statistically significant difference between feeling physically well and comfortable, feeling relaxed, having control over the treatment process, imagining how the drug is working in the body, being motivated to continue treatment, and having an overall positive attitude with the next dose. Overall, the majority of respondents (62.2%) said they would like to use the application again. While there was no difference in adverse events between the 2 groups, some patients reported difficulty with navigating the game. Nevertheless, no patients ruled out repeated use of this application at future infusion appointments. These suggest overall improvements in surrogates for anxiety and stress related to treatment, and this has potential implications for improving treatment compliance. However, this study is limited by its lack of blinding with a sham VR arm, single centre experience, and use of a single short VR session.

Another study investigated the perspectives of paediatric patients and parent(s)/guardian(s) on the feasibility and acceptability of VR during a routine infusion appointment and its effects on medical trauma at a single centre.³⁷ Interviews were conducted with 18 patient-parent/guardian dyads with

an average patient age of 13 years, and the majority being non-Hispanic White (89%) with private insurance (94%). All patients were already familiar with VR, and 61% had prior experience. The authors found that patients felt VR could distract from the infusion procedure and possibly allow for positive anticipatory excitement for future appointments. Parents of patients also reported the potential for relief in their own anxiety if VR helped their child with anxiety or pain during the appointment. Concerns that were raised included side effects such as dizziness and nausea, increased screen time, addiction, limited mobility during the procedure, disorientation, parental loss of control, and lost opportunity to build resilience and coping strategies with an over-reliance on technology. Though this study did not include a VR intervention, it does highlight the need to explore and optimize the use and safety of VR in this population. While the perspectives noted in this report can help inform outcome measures and the design of future studies, it is also prudent to include the perspectives of a more diverse population to allow generalizability.

In an observational pilot study of 87 patients at a single centre in Spain, satisfaction and acceptance of VR through the use of 3D glasses were assessed at a routine infusion appointment, and surveys were administered before and after the use of VR.³⁸ The authors found that patients noted a reduction in stress (65%, $P = 0.0021$) and pain (54%, $P < 0.05$), and greater overall well-being during the appointment was reported (56%, $P = 0.0014$) without a greater incidence of side effects. However, this study did not include a control group.

VR during clinic appointments

In a study of paediatric and young adult patients with IBD at a single centre, a mindfulness-based VR intervention was delivered through a headset to 62 individuals between the ages of 10 and 25 years during a routine clinic appointment.³⁹ Participants were brought into a private clinic room before or after their scheduled clinical appointment where they completed a 6-minute mindfulness-based VR intervention with surveys pre- and post-intervention and a debriefing interview afterwards. This application was developed with the involvement of a paediatric IBD psychologist, gastroenterologist, and paediatric pain anaesthesiologists. The program utilized a narrator to guide the user through mindfulness-based exercises, including focusing on one's breathing and physical sensations in their body and shifting focus to peaceful immersive environments such as a peaceful meadow with a waterfall. Participants overall reported high levels of acceptability and satisfaction and about half reported being interested in having additional sessions in other IBD clinical settings (inpatient hospitalization, procedures, treatments, labs) or at home to be used during their daily life. The authors also reported a significant decrease in anxiety (16.61 ± 20.84 to 7.09 ± 13.36 ; $P = 0.001$) and pain (9.97 ± 16.51 to 3.15 ± 6.38 ; $P < 0.001$) post-intervention. However, this study did not include a control arm, and although there was a statistically significant difference in pain and anxiety post-intervention, it is unclear if these differences were clinically significant.

VR in patient education

VR has been shown to help with peri-procedural anxiety in patients undergoing a colonoscopy.⁴⁰ In a 2-year prospective randomized control trial of 346 patients, VR was used

to provide patient education for bowel preparation prior to colonoscopy compared to standard educational methods.⁴¹ The authors found that VR-based education prior to the procedure yielded higher satisfaction (mean, 8.68 vs. 8.16; $P = 0.01$), improved compliance (68.8% vs. 50.3%; $P < 0.001$), the improved adenoma detection rate for polyps (41.9% vs. 26.7%; $P = 0.003$) and adenomas (32.6% vs. 22.1%; $P = 0.03$). However, the patient population was notable for those with a high educational background and socioeconomic status, which may limit generalizability. As patients with IBD undergo frequent colonoscopies requiring bowel preparation, the use of VR in this setting may be useful though further investigation in this population is required.

Discussion

Patients with IBD can experience disabling symptoms such as abdominal pain, urgency, and diarrhoea which may not always be related to active inflammation. Patients may experience symptoms related to a DGBI.²⁴ In addition, concomitant mental health disorders have a greater incidence in this population and contribute to poorer coping skills and quality of life. Therefore, patients with IBD are adequately served by a team of gastroenterologists and surgeons along with mental health professionals. While accessibility to mental health services can be limited by multiple factors, the use of virtual reality may help bridge this gap and has been shown to be effective in patients with anxiety, pain and other psychiatric co-morbidities,^{27-29,33} and feasible and acceptable in patients with DGBI.³² Here, we review the utility of VR in patients with IBD.

VR has been studied in IBD patients undergoing infusions. A significant portion of patients with moderate-to-severe disease require biologic therapy which includes intravenous infusions during induction and possibly during maintenance. Several studies investigated brief interventions with VR during these regularly scheduled appointments. One session of a VR intervention was generally received positively (7.79 out of 9),³⁵ and another study showed a reduction in stress (65%, $P = 0.0021$), pain (54%, $P < 0.05$), and improved overall well-being (56%, $P = 0.0014$).³⁸ In addition, compared to routine management during an infusion of vedolizumab, subjects found a VR intervention promoted feeling well and comfortable, having more control over the treatment process, being motivated to continue treatment, and having an overall positive attitude with the next dose.³⁶ Perspectives such as this may improve patient adherence, however further studies with repeated interventions in diverse populations will be required to see how this influences long-term clinical outcomes. Moreover, real concerns exist among patients and respective parents/guardians,³⁷ and additional investigation regarding potential adverse effects, especially with multiple VR interventions is necessary.

There may also be utility in providing this intervention outside of infusion appointments. In 1 study, a brief mindfulness-based VR session during a clinic appointment led to significant reductions in pain and anxiety afterwards.³⁹ VR was also shown to be useful for education. It was used in patients receiving vedolizumab to educate on the mechanism of action of the drug which was received positively.³⁶ Moreover, it was used in educating patients about proper colonoscopy preparation which resulted in greater satisfaction (mean, 8.68 vs. 8.16; $P = 0.01$), improved compliance

(68.8% vs. 50.3%; $P < 0.001$), and improved adenoma detection rate for polyps (41.9% vs. 26.7%; $P = 0.003$) and adenomas (32.6% vs. 22.1%; $P = 0.03$).⁴¹ This is particularly useful in patients with IBD who often require more frequent surveillance colonoscopies and more study is needed to see how VR-based education may influence dysplasia detection.

Future applications

Several potential applications exist for the use of VR in patients with IBD, summarized in [Table 1](#).

Patient support groups provide the opportunity to engage with peers and share similar experiences while also sharing empathy with others. However, there are multiple barriers to getting these organized, including the burden of appointments, geographic constraints, the need for hospitalization, and physical stigma. VR has been used in oncology to create a therapist-guided social space to enable support group sessions, and this was found to be feasible and acceptable in a small pilot study.⁴² As patients can select their own avatar during these sessions, some degree of anonymity is allowed which may help patients overcome hesitation and be more forthcoming with issues. As patients with IBD can share similar barriers to accessing support groups, there may be a role for VR in improving accessibility to this valuable resource for patients.

In addition to patient support groups, VR could be utilized regularly at home. The regular use of VR in this setting is being studied in other digestive diseases such as DGBIs,³¹ and this may potentially be impactful in patients with IBD who do not require infusion-based therapies or have less frequent clinic appointments. A longitudinal assessment of VR in combination with artificial intelligence to manage anxiety in patients with IBD is currently being studied (Clinicaltrials.gov identifier NCT06575660).

Table 1. Potential applications of VR in IBD.

Area of interest	Potential applications
Patient education	Improved awareness of IBD, drug mechanisms, and treatment options
Symptom support and monitoring	Support for symptoms of abdominal pain, urgency
Mental health support	Treatment of depression, anxiety, and phobias
Support groups	Connection of patients with similar disease regardless of geographic location of participants
Lifestyle	Diet and physical activity
Endoscopy	Bowel prep education, management of discomfort, interpretation of endoscopic inflammation, and interpretation of histologic inflammation
Surgery	Pre-operative planning, IBD surgery training, post-operative recovery, and rehabilitation
Clinical trials	Patient recruitment and engagement, remote symptom monitoring, community building, and data collection
Treatment of inflammation	Precision treatment plans, potential brain-gut treatment of inflammation, passive disease monitoring based on indirect measures
Healthcare providers	Understanding patient experiences

VR has also been studied in endoscopy training, and this has been shown to be an effective modality for learning and has the potential to enhance trainee endoscope manipulation, procedure duration, psychomotor skills, technical precision, and patient discomfort.⁴³ Specific VR applications to be used in IBD endoscopic training are needed, including training on various endoscopic scoring systems used in UC, CD, and patients with a pouch.

VR may be used as a helpful adjunct in surgery. In a study of 13 patients with colorectal cancer undergoing a variety of surgeries including an ileocecal resection, right hemicolectomy, a partial colectomy, and/or lymph node dissection, it was found that a 3D hologram of the patient's pre-operative cross-sectional imaging improved understanding of a patient's anatomy without increased physical or mental demand based on surveys.⁴⁴ VR simulations have also been validated to train during dissection in a laparoscopic sigmoid colectomy.⁴⁵ In a systematic review of patient-specific pre-operative planning, VR improved surgeon-specific outcomes such as surgical strategy, anatomy visualization, and confidence, though patient-specific outcomes were unchanged.⁴⁶ More research is needed to identify opportunities for VR in training and preparation prior to complex IBD surgeries.

Conclusion

There is a great need for improved support of DGBI and mental health disorders in patients with IBD, and VR may be a useful resource to help bridge this gap. Potential areas for VR-based interventions in this population include during infusions, clinic appointments, and procedures. Current data after a single VR-based session in this population show promising results, and further studies in larger, more diverse populations will be required longitudinally. Current trials are ongoing to further assess the role of VR in IBD including pain (NCT06188793).

Author contributions

Rajsavi Anand and Alvin T. George are considered as co-first authors of this work. Conception, resources, supervision, writing, review, and editing are all equal among authors.

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Conflict of interest

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Data availability

There are no data associated with this manuscript.

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