ORIGINAL ARTICLE

Gastrointestinal ultrasound in inflammatory bowel disease care: Patient perceptions and impact on disease-related knowledge

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Key words
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Abstract

Background and Aim: Objective monitoring of disease activity is integral to therapeutic decision-making in inflammatory bowel disease (IBD). Data are sparse on patients’ perspectives of tools used to monitor disease activity in IBD. To evaluate patients’ perspectives of gastrointestinal ultrasound (GIUS) performed during routine IBD clinical care, along with its impact on IBD-specific knowledge.

Methods: Patients with a formal diagnosis of IBD who underwent GIUS at two tertiary IBD services between March 2017 and January 2019 participated in this prospective study. Participants completed a questionnaire measuring the acceptability, tolerability, and usefulness of GIUS using a visual analogue scale (VAS) from 0 (disagree) to 10 (strongly agree). Comparative acceptability of IBD monitoring tools and the impact of GIUS on IBD-specific knowledge was measured.

Results: A total of 121 participants completed the questionnaire, with a mean age of 42 years (range 17–78), 54 (45%) males, and 79 (65%) Crohn’s disease patients. In the overall population, GIUS was scored as highly acceptable for monitoring IBD (mean 9.20 ± 1.37) compared to colonoscopy (7.94 ± 2.30), stool sampling (8.17 ± 1.96), blood sampling (8.87 ± 1.62), and imaging (8.67 ± 1.60); P < 0.01 for each comparison. GIUS caused little patient discomfort (1.88 ± 1.83), and 98 (81%) participants ranked GIUS as their preferred IBD monitoring tool. GIUS also improved patients’ overall IBD-specific knowledge (VAS IBD-specific knowledge 7.96 ± 1.92), including their understanding of the need for medical therapy and disease extent.

Conclusion: GIUS is a highly acceptable and well-tolerated tool for monitoring disease activity in IBD patients. GIUS is preferred by patients and enhances IBD-specific knowledge.

Introduction

The advent of highly effective therapies for inflammatory bowel disease (IBD) has raised treatment expectations.1 Beyond managing clinical symptoms alone, the goal of therapy in IBD is now to ameliorate objective inflammation.1 Attainment of endoscopic mucosal healing in IBD is associated with decreased rates of hospitalization, surgery, and steroid use and a reduction in the risk of malignancy.2–4 Beyond endoscopic mucosal healing, histological healing may further reduce the risk of disease flare.7

In this “treat to target” era of IBD management, objective monitoring of disease activity is required to guide treatment decisions. International consensus guidelines suggest endoscopic reassessment at frequent intervals while adjusting therapy.1 While endoscopy is considered the gold-standard modality of assessment in IBD, the substantial health economic burden of endoscopy on health-care systems needs to be considered, along with the risks, costs, and inconvenience to patients. As a result, it has never been more important to evaluate alternative tools for objective disease activity assessment in IBD.

Gastrointestinal ultrasound (GIUS) is an accurate and non-invasive tool for the assessment of disease activity in IBD.8 GIUS has been shown to have comparable accuracy in terms of establishing disease activity and extent for both ulcerative colitis (UC) and Crohn’s disease (CD) compared to both ileocolonoscopy and other imaging modalities, including computed tomography (CT) and magnetic resonance imaging (MRI).1,8–10 GIUS has also been shown to closely correlate with
Table 1 Demographics and disease characteristics

|                        | Overall | CD   | UC   |
|------------------------|---------|------|------|
| Total (n)              | 121     | 79   | 42   |
| Age (mean ± SD/median IQR) | 42 ± 17/39 (28, 55) | 42 ± 16/42 (28, 54) | 45 ± 17/38 (29, 57) |
| Male (n, %)            | 54 (45) | 32   | 22   |
| Disease duration—years (median IQR) | 7 (2–19) | 7 (2–21) | 6 (2–16) |
| Medications (n, %)     |         |      |      |
| 5-ASA                  | 41 (34) | 7 (9) | 34 (81) |
| Immunomodulator        | 54 (45) | 40 (51) | 14 (33) |
| Biologic               | 38 (31) | 31 (39) | 7 (17) |
| Corticosteroid         | 20 (17) | 11 (14) | 9 (21) |
| No treatment           | 17 (14) | 16 (20) | 1 (2) |
| Montreal classification| A1 18  | A1 12 (15%) L1  | A1 6 (14%) |
|                        | (15%)   | 32 (41%) B1 | E1 6 |
|                        |         | 38 (48%) | (14%) |
|                        | A2 71  | A2 48 (61%) L2 | A2 23 |
|                        | (59%)   | 15 (19%) B2 | (55%) E2 |
|                        |         | 21 (27%) | 27 (64%) |
|                        | A3 32  | A3 19 (24%) L3 | A3 13 |
|                        | (26%)   | 32 (40%) B3 | (31%) E3 |
|                        |         | 20 (25%) | 9 (22%) |
|                        |         | P 8 (10%) | |
| Sonographic disease activity (n, %) | 64 (53) | 42 (53) | 22 (52) |

ASA, aminosalicylic acid; Montreal classification; CD, Crohn’s disease; IQR, interquartile range; UC, ulcerative colitis.

Table 2 Acceptability, usefulness, and tolerability of gastrointestinal ultrasound

| Domain (mean SD, median IQR) | CD       | UC       | Overall |
|------------------------------|----------|----------|---------|
| Acceptability                | 9.17 ± 1.31, 10 (9–10) | 9.27 ± 1.50, 10 (9–10) | 9.20 ± 1.37, 10 (9–10) |
| Usefulness                   | 9.10 ± 1.18, 10 (8.75–10) | 8.83 ± 1.65, 10 (8–10) | 9.01 ± 1.36, 10 (8–10) |
| Tolerability                 | 1.77 ± 1.40, 1 (1–2) | 2.07 ± 2.46, 1 (1–2) | 1.88 ± 1.83, 1 (1–2) |

CD, Crohn’s disease; IQR, interquartile range; UC, ulcerative colitis.

endoscopic mucosal healing in both UC and CD and is able to identify transmural healing in the setting of CD. GIUS is useful in the identification of complications such as abscesses and fistulae. It holds advantages over other tools of disease activity assessment in that it is noninvasive, relatively inexpensive, and nonradiating, and the equipment is widely available. GIUS can also be undertaken at the point of care to allow real-time clinical decision-making to triage and expedite appropriate further investigations and management. In many international centers, GIUS is incorporated into routine IBD assessment. In other countries, such as Australia, uptake of GIUS has been slow, limited by a lack of training opportunity, a perception of operator dependence, and a reticence to adopt GIUS into established algorithms of IBD management.

Patient perceptions of tools for monitoring IBD are often overlooked. Endoscopic assessment is invasive and requires bowel preparation, as do other imaging modalities. There is a paucity of data evaluating patients’ experience of monitoring tools in IBD. Small studies have shown that noninvasive tests such as imaging and blood and stool sampling are preferred over endoscopic assessment among IBD patients. There are also data to suggest high levels of satisfaction among both IBD and other patient cohorts with the use of abdominal ultrasound as a diagnostic test. GIUS also has the potential to improve patient knowledge of their disease.

The aims of this study were therefore to: (i) evaluate patient perspectives of GIUS as part of routine clinical care, particularly the tolerability and acceptability of GIUS; (ii) to evaluate patient preferences of tools used for monitoring IBD disease activity; and (iii) to evaluate the capacity for GIUS to improve IBD illness-related knowledge.

Methods

Subjects. Consecutive patients with a formal diagnosis of IBD managed by two tertiary IBD services who underwent GIUS during routine clinical care were invited to participate in this prospective study between March 2017 and January 2019. GIUS was requested by the treating clinician to evaluate the activity and extent of IBD in order to inform treatment decisions. Participants were provided with a written information sheet prior to provision of informed consent. All patients undergoing GIUS examination with a formal diagnosis of IBD who provided consent were eligible for inclusion in the study.

GIUS examination. GIUS was performed by four accredited sonographers (as recognized by the Gastrointestinal Network of Intestinal Ultrasound) at the point of care, whether this was in the clinic, endoscopy suite, or ward setting. GIUS was performed using a Toshiba Aplio 500 ultrasound unit with a low-frequency (1–6 MHz) and high-frequency (3–11 MHz) transducer or a Hitachi Aloka Prosound F75 with a low-frequency convex transducer (1–6 MHz) and a high-frequency linear transducer (3–13 MHz). No patient preparation was required. A transabdominal approach was used for all assessments, with systematic evaluation of the gastrointestinal tract as previously described. Each assessment lasted 10–20 min, and the results of the examination were recorded on a standardized reporting template. In the absence of a validated scoring system to define active IBD on GIUS, a proposed scoring system20 was applied prospectively to each examination. Active disease was defined as an increase in bowel wall thickness > 4 mm accompanied by an increase in color Doppler signal. Disease was considered inactive if the above variables were within normal limits.
other modalities used to assess luminal disease activity, that is, CT enterography and/or magnetic resonance enterography, which were named as such in the questionnaire. Participants were only asked to provide scores for tools they had experienced.

**Ethics.** This study was approved by the Central Adelaide Local Health Network Research Ethics Committee (R20170209, February 2017) and the Mater Health Service Human Research Ethics Committee (HREC/18/MHS/75).

**Statistical analysis.** Data were described as proportions, mean ± SD, or median and interquartile range (IQR) as appropriate. Comparison between the acceptability of monitoring tools in IBD was performed using the Wilcoxon test for nonparametric, paired data. Statistical analysis was performed using Graphpad PRISM software, version 7.04 (San Diego, CA, USA).

**Results**

**Patient demographics.** A total of 121 patients underwent GIUS and completed the questionnaire within the study period. The response rate was 100% (all patients who underwent GIUS and consented to this study returned a questionnaire on the same day); 54 (45%) patients were male, 79 (65%) had CD, and the mean age was 42 ± 17 years (Table 1).

**Patient perceptions of GIUS.** GIUS was considered a highly acceptable (VAS median [IQR] 10 [9–10], mean SD 9.21 ± 1.37) and useful (10 [8, 10], 9.01 ± 1.36) tool for IBD monitoring by the participants. GIUS was also found to cause little discomfort (1 [1, 2], 1.88 ± 1.83). There was no difference between CD and UC phenotypes in patient perceptions of GIUS (Table 2) (Fig. 1).

**Comparative acceptability of monitoring tools in IBD.** All 121 patients underwent and rated GIUS; 114 patients rated colonoscopy (76 CD), 106 rated stool sampling (67 CD), 113 rated blood sampling (74 CD), 70 rated imaging (70 CD), and 42 rated flexible sigmoidoscopy (0 CD).

Overall, GIUS was ranked as significantly more acceptable when compared to colonoscopy (VAS median [IQR] 8 [7–10], mean SD 7.92 ± 2.29, P < 0.01), stool sampling (9 [7, 10], 8.34 ± 1.87, P < 0.01), blood sampling (10 [8, 10], 8.95 ± 1.60, P < 0.01), and imaging (9 [8, 10], 8.70 ± 1.65, P < 0.01). When evaluated by phenotype, GIUS remained the preferred

Table 3 Comparative acceptability of gastrointestinal ultrasound compared to other inflammatory bowel disease-monitoring tools

| Modality (mean SD, median IQR) | CD           | P     | UC           | P     | Overall | P     |
|-------------------------------|--------------|-------|--------------|-------|---------|-------|
| GIUS                          | 9.17 ± 1.31, 10 (9–10) | —     | 9.27 ± 1.50, 10 (9–10) | —     | 9.21 ± 1.37, 10 (9–10) | —     |
| Colonoscopy                   | 7.92 ± 2.29, 8 (7–10)  | <0.01 | 8.00 ± 2.36, 8 (6–10) | <0.01 | 7.94 ± 2.30, 8 (7–10) | <0.01 |
| Stool Sampling                | 8.34 ± 1.87, 9 (7–10)  | <0.01 | 7.89 ± 2.10, 8 (6–10) | <0.01 | 8.17 ± 1.96, 9 (7–10) | <0.01 |
| Blood sampling                | 8.95 ± 1.60, 10 (8–10) | 0.15  | 8.72 ± 1.69, 9 (8–10) | <0.01 | 8.87 ± 1.62, 10 (8–10) | <0.01 |
| Imaging                       | 8.70 ± 1.65, 9 (8–10)  | 0.04  | NA           |       | 8.67 ± 1.60, 9 (8–10) | <0.01 |
| Sigmoidoscopy                 | NA           |       | 8.00 ± 1.95, 8 (7–10) | <0.01 | NA      |       |

P < 0.05 statistically significant.

—, reference; CD; Crohn’s disease; GIUS, gastrointestinal ultrasound; IQR, interquartile range; NA, not applicable; UC, ulcerative colitis.
monitoring tool for patients with UC; however, in patients with CD, both GIUS and blood sampling were preferred over colonoscopy (Table 3) (Fig. 2).

**GIUS and IBD-related knowledge.** GIUS had a substantial impact on patient understanding of IBD disease extent (VAS median [IQR] 8 [7–10], mean SD 7.96 ± 1.93) and disease activity (9 [7, 10], 8.05 ± 2.13). Moreover, improved understanding was achieved regarding the need for therapy (8 [7, 10], 7.84 ± 2.19) and the importance of treatment adherence (9 [7, 10], 8.15 ± 2.05). Overall, study subjects reported that GIUS substantially improved their overall IBD disease-related knowledge (8 [7, 10], 7.96 ± 1.92). Similar results were evident in the CD and UC subgroups (Table 4).

**Discussion**

GIUS in routine IBD care was found to be highly acceptable and tolerable to patients with IBD and was preferred over other tools of monitoring disease activity. Moreover, patients with IBD reported that GIUS improved their IBD-related knowledge and provided them with an enhanced understanding of their need for IBD therapy. The patient experience of diagnostic tests in IBD is rarely reported but should be considered, particularly in this era of close and objective monitoring of disease, to inform treatment decisions.1

Current guidelines suggest that endoscopy be used to monitor disease activity in IBD.1 The frequency of endoscopic assessment in IBD is used to increase the likelihood of achieving endoscopic mucosal healing.1,23 However, there is insufficient acknowledgement of the burden of endoscopy on patients and health-care systems in terms of tolerability, resource utilization, and invasive risks. Tolerability is a key metric for any diagnostic test, particularly one that needs to be used repeatedly for monitoring disease. In this study, GIUS was associated with no or minimal patient discomfort. Accordingly, GIUS was ranked as the preferred tool for monitoring by the evaluated IBD cohort. Previous studies in IBD have shown that noninvasive tests are preferred to invasive tests, such as colonoscopy, because of factors such as the need for bowel preparation and discomfort of the test.18,24–26 In this study,

**Table 4** Impact on inflammatory bowel disease-related knowledge

| Domain              | CD                      | UC                      | Overall              |
|---------------------|-------------------------|-------------------------|----------------------|
| Disease extent      | 8.07 ± 1.77, 8 (7–10)   | 7.75 ± 2.21, 8 (7–10)   | 7.96 ± 1.93, 8 (7–10) |
| Disease activity    | 7.99 ± 2.07, 8 (7–10)   | 8.17 ± 1.99, 9 (7–10)   | 8.05 ± 2.03, 9 (7–10) |
| Need for therapy    | 7.65 ± 2.35, 8 (6–10)   | 8.21 ± 1.81, 8 (7–10)   | 8.74 ± 2.19, 8 (7–10) |
| Treatment adherence | 7.93 ± 2.18, 9 (6–10)   | 8.57 ± 1.72, 9 (8–10)   | 8.15 ± 2.05, 9 (7–10) |
| Overall knowledge   | 7.93 ± 1.86, 8 (7–10)   | 8.00 ± 2.05, 8 (7–10)   | 7.96 ± 1.92, 8 (7–10) |

CD, Crohn’s disease; IQR, interquartile range; UC, ulcerative colitis.
GIUS was preferred over all other tests, including noninvasive options such as blood collection and stool sampling.

GIUS was found to have a positive impact on IBD-related knowledge among study participants. Physicians are able to both discuss and educate patients about their disease in real time, allowing for improved understanding of the underlying disease process and the need for treatment, as well as strengthening physician–patient relationships. This is likely to improve patient adherence to medications and have a long-term, positive benefit on their disease outcome. More recently, it has been shown that patients with active IBD who undergo GIUS report greater adherence to therapy.

This study is strengthened by its prospective multicenter methodology and recruitment of consecutive patients undergoing GIUS. As opposed to previous studies assessing acceptability of IBD tools, this study also looked at the impact on disease-related knowledge, and to the author’s knowledge, this is the first study performed in Australia to evaluate GIUS in this manner. Although there is no validated tool for evaluating patient perceptions of diagnostic tests, a VAS was used, which was similar to previous studies. Administration of a questionnaire soon after a test also raises the possibility of recall bias in reporting comparative acceptability. The study is limited by the lack of assessment of the impact on disease-related knowledge of other investigational tools, the lack of a formal definition of clinical usefulness (rather, this was the patient impression of clinical usefulness), and the lack of presentation of accuracy data, limiting the interpretation of clinical utility of GIUS.

In conclusion, GIUS is a highly acceptable and well-tolerated tool for monitoring disease activity in IBD and is preferred by patients over other modalities. Moreover, GIUS enhances IBD-specific knowledge and improves patients’ understanding of the need for medical therapy. Further research is required to determine the true impact of GIUS on adherence to therapy and IBD outcomes. The reported accuracy of GIUS in evaluating IBD disease activity and extent, coupled with patients’ preference and tolerability, makes a compelling case for its use in routine IBD care.

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Supporting information

Additional supporting information may be found in the online version of this article at the publisher’s website:

Table S1 Questionnaire: Patient perspectives of gastrointestinal ultrasound.