

ORIGINAL ARTICLE

Fecograph: A graphical representation of daily stool forms to subtype irritable bowel syndrome in office practice

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Abstract

Background and Aim: Interpreting stool form diaries for subtyping patients with the irritable bowel syndrome (IBS) is cumbersome; a picture showing a trend would be easier to interpret.

Methods: Fifty-one consecutive adults with IBS (median age 35.5 years; 47 men), diagnosed using the Rome III criteria, were given a picture of the Bristol stool form scale (BSFS) and asked to record their stool frequency and form for 7 days. The numbers were plotted by a technician as dots on a chart. On the y axis, BSFS category 4 was marked as 0, harder stools as +1 to +3, and softer stools as -1 to -3; each bowel movement was represented on the x axis. A line graph was plotted by connecting the dots. Each “fecograph” was then given for visual interpretation to three gastroenterologists (observers). When most readings appeared to be 0, +1, or -1, it was to be reported as normal; most above +1 as IBS-constipation (IBS-C); most below -1 as IBS-diarrhea (IBS-D); and readings crossing 1 on either side as IBS-mixed (IBS-M). If no clear trend was noted, it was IBS-unclassified (IBS-U). Each observer reported all graphs in different orders twice, at 1-month intervals; thus, 306 reports were available. Interclass correlation coefficient (ICC) was calculated.

Results: Eighteen patients had IBS-C, 13 IBS-D, 4 IBS-M, and 16 IBS-U. The 51 fecographs were reported in mean 20 min 36 s. ICC for intra- and interobserver reliability was 0.62 (0.50–0.73).

Conclusion: The fecograph is a reliable and easy-to-use tool to subtype patients with IBS.

Introduction

The Bristol stool form scale (BSFS) was devised in 1990 for patients with irritable bowel syndrome (IBS) to help differentiate between true diarrhea (loose stools) and pseudo diarrhea (normal or formed stools, with increased stool frequency).¹ Subsequently, the BSFS was used to evaluate stool frequency and form in the community.² BSFS illustrates the common stool forms and consistency on a 7-point scale with simple visual descriptors. It is easily understood by patients, who recognize and classify the stool type that most closely represents their own.³ It has been validated in a number of studies for the classification of stool form.^{4–6}

The BSFS scale has been recommended as a modality to subtype patients with IBS as IBS-C (constipation-predominant), IBS-D (diarrhea-predominant), IBS-M (mixed), and IBS-U (unclassified) based on the type of stool passed over the previous 7 days.^{6,7} The scale is a good tool for research but is cumbersome for use in a busy clinic. A pictorial chart has been devised to facilitate classification, but this also needs the calculation of the total number of stools in each category and the percentage of predominant stool type.³

A visual impression of a pattern would be easier to interpret. We designed a graph on which a patient’s daily stool form and frequency can be plotted and evaluated its utility as a semi-quantitative tool to subtype patients with IBS in a short time.

Methods

Consecutive adult patients visiting the outpatient Gastroenterology clinic at the KEM Hospital and diagnosed as having IBS using the Rome III criteria⁸ were enrolled. The institution ethics committee reviewed and approved the protocol. Informed consent was obtained from all participating patients.

The BSFS was given to patients along with the pictorial diagram. They were instructed, in a language they understood, to record each stool passage and stool form according to the BSFS at each passage for a period of 7 days. During this period, they were encouraged to take their routine diet and perform routine activities. Patients with concomitant illnesses that could affect stool pattern and those taking drugs affecting stool pattern or transit were excluded.

When patients returned, they were asked if they had any difficulty in marking the information. They were also asked if

they had difficulty in recognizing the stool form and characterizing them according to the BSFS.

Using the data from each patient's chart, a technician prepared a line graph that had stool number on the x axis (to a maximum of 30 numbers for a 7-day period) and stool type on the y axis (Fig. 1a). BSFS category 4 was designated as 0 on the y axis; harder stools were graded as +1 to +3 and softer stools as -1 to -3 (Table 1).

All the graphs were coded and given to three gastroenterologists (observers) on two occasions at a 1-month interval. These observers had at least 5 years' experience as faculty at a university hospital/tertiary care center and were blinded to clinical details. The time taken to classify the graphs was recorded by the technician. The observers were invited to independently study these graphs and subtype patients based on graph patterns, as follows:

- Graphs with most (based on visual impression) readings between +1 and -1 to be reported as N (normal)
- Graphs with most readings above +1 reported as C (constipation)
- Graphs with most readings below -1 reported as D (diarrhea)
- Graphs with readings crossing 1 on either side reported as M (mixed)
- If no clear trend was seen, graphs were to be reported as U (unclassified)

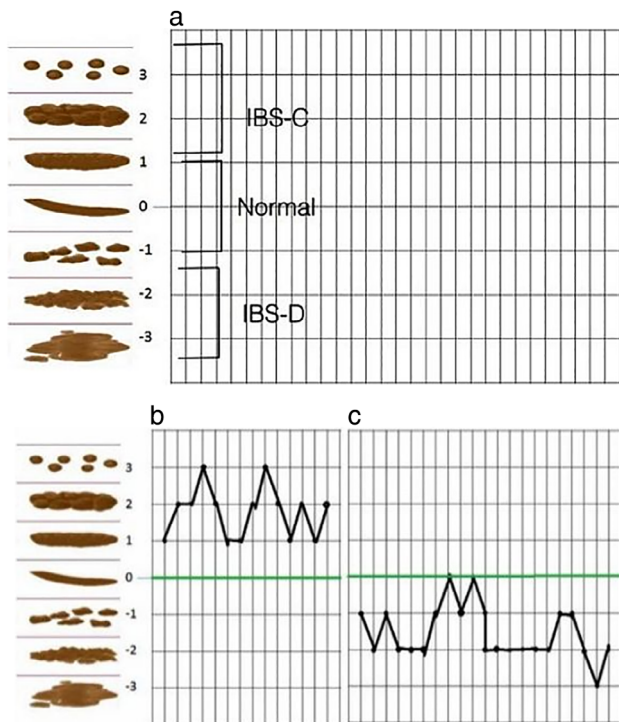


Figure 1 (a) Patterns for classifying the patients into categories of IBS according to the Bristol stool chart. (b) Fecograph of a patient with IBS constipation. (c) Fecograph of a patient with IBS diarrhea. The mixed-pattern IBS patient had a graph fluctuating on both sides of the green line. IBS, irritable bowel syndrome.

Table 1 Category comparisons for reporting fecograph

BSFS category	Fecograph
1	+3
2	+2
3	+1
4	0
5	1
6	2
7	3

BSFS, Bristol stool form scale.

Statistical analysis. To analyze intra- and interobserver agreement, interclass correlation coefficient (ICC) was calculated (SPSS software, version 16, IBM, Armonk, USA). Correlation of the diagnosis based on the graph with that based on the BSFS chart was assessed using Pearson correlation coefficient. Two-way ANOVA with mixed-type analysis was performed as all observers had rated all the patient graphs; the analysis was conducted by absolute agreement over individual values and by consistency over the categories. Cronbach's alpha was calculated to look for internal consistency and generalizability.^{9,10} Variances by item and observers were also calculated.

Results

The age of the 51 participating patients (47 men) was a median 35.5 (range, 19–64) years. Eighteen (35.3%) patients had IBS-C, 13 (25.5%) IBS-D, 4 (7.8%) IBS-M, and 16 (31.4%) IBS-U as per the Rome III criteria. The mean time taken to analyze all 51 graphs by the observers was 20 min 36 s (range, 17 min 49 s to 23 min 43 s), that is, approximately 24 s per graph.

Table 2 depicts how individual observers reported the graphs each time. Of the total 306 reported graphs (51 graphs interpreted twice 1 month apart by three observers), there was difficulty in subtyping stool types as normal or unclassified on 18 occasions (5.8%) in 13 graphs. These were considered unclassified for the purpose of analysis. Analysis was therefore performed for all patients (Analysis 1), after excluding the 18 occasions in which at least one observer had difficulty reporting the graph (Analysis 2).

ICC for intra- and interobserver reliability was 0.62 (95% confidence interval [CI] 0.50–0.73) for single measures and 0.91 (95% CI 0.86–0.94) for average measures. Interitem correlation matrix for agreement is shown in Table 2; Cronbach's alpha was 0.91.

Table 2 Interitem correlation matrix for fecograph (n = 51)

	O1R1	O2R1	O3R2	O2R2	O1R2	O3R1
O1R1	1.000	0.529	0.618	0.595	0.808	0.482
O2R1	0.529	1.000	0.626	0.662	0.523	0.621
O3R2	0.618	0.626	1.000	0.683	0.693	0.611
O2R2	0.595	0.662	0.683	1.000	0.753	0.635
O1R2	0.808	0.523	0.693	0.753	1.000	0.560
O3R1	0.482	0.621	0.611	0.635	0.560	1.000

Table 3 Interitem correlation matrix for fecograph after excluding 13 graphs ($n = 38$)

	O1R1	O2R1	O3R1	O1R2	O2R2	O3R2
O1R1	1.000	0.792	0.766	0.846	0.618	0.676
O2R1	0.792	1.000	0.883	0.666	0.732	0.588
O3R1	0.766	0.883	1.000	0.824	0.844	0.760
O1R2	0.846	0.666	0.824	1.000	0.767	0.730
O2R2	0.618	0.732	0.844	0.767	1.000	0.715
O3R2	0.676	0.588	0.760	0.730	0.715	1.000

In Analysis 2 (excluding the 13 problem graphs), the ICC was 0.74 (0.64–0.91) for single measures and 0.95 (0.91–0.96) for average measures (Table 3). Cronbach's alpha was 0.95.

Correlation with diagnosis by the BSFS was performed after excluding the difficult observations ($n = 13$ patients) so that the number of categories would match. The correlation matrix for Pearson correlation is shown in Table 4. There was good correlation between the classification of IBS subtype by the BSFS and the fecograph ($P = 0.01$).

Of 108 graphs, 90 (83.3%) in 18 patients with IBS-C on BSFS were reported similarly with the fecograph; 69 of 78 (88.6%) graphs in 13 patients with IBS-D were also identified similarly. Of those with IBS-U on BSFS (16 patients), 48 of 96 observations (50%) were reported as having normal stool type on the fecograph and 10 (10.4%) as unclassified, 17 (17.7%) as constipation, 13 (13.5%) as diarrhea, and 8 (8.3%) as mixed types. Of those with IBS-M on BSFS (4 patients), 16 of 24 observations (66.7%) were reported as mixed type on the fecograph, 6 of 24 (25%) as constipation, and 1 (4.2%) each as diarrhea and indeterminate types.

Discussion

The fecograph we devised showed good internal consistency and generalizability, reliability and reproducibility, and good correlation with the standard BSFS diagnoses.

The Bristol stool chart has been recommended by the Rome Committee for the classification of IBS types. One of the limitations of this chart in office practice is the time taken for calculation and interpretation. The fecograph correlates well with the subtype of IBS on BSFS, and its interpretation can be carried out in less than half a minute. We believe the fecograph can be gainfully incorporated into clinical practice.

An additional advantage of the fecograph is that values can be plotted anywhere between confusing values, that is, if a patient believes his or her stool is a mix of types 2 and 3, a dot can be put between the two on the y axis to overcome this problem. In our study, of 16 patients classified as IBS-U by the BSFS, 5 had normal stool consistency most of the times; these may be classified as having only functional abdominal pain.

There was difficulty in subtyping stool types by BSFS in 5.8% of stools we included. On these occasions, the observers mentioned inadequate number of stools plotted as the reason. In our study, most disagreements were seen in graphs where the number of total stools per week was not enough to demonstrate a clear pattern. A possible solution is to record stool pattern for more days (maybe up to 30 bowel movements) rather than the 7 days to which we restricted it.

The interrater and intrarater reliability of the BSFS by individual stool type has been shown to be high in various studies. In a large study, Chumpitazi *et al.*¹¹ showed that, of the seven BSFS types, there was absolute agreement for types 1 or 7, but for types 2 through 6, the ratings were within one category type of the modal rating. Overall, the intraclass correlations for interrater reliability of the BSFS by individual stool type was 0.88 and that for intrarater reliability was 0.89. However, the interrater agreement decreased significantly to 0.75 (95% CI 0.69–0.81) when categorizing the stool form types according to the diagnosis of IBS using Rome III criteria.

Our study had limitations. Subsequent to the initiation of our study, the Rome IV criteria for IBS subtyping were published.¹² These specified that subtyping should be based on the patient's reported predominant bowel habit on days with abnormal bowel movements, and subtype should be based on 14 days of daily diary reports. The average normal Indian stool frequency is once a day⁶; a national epidemiological study had shown that the frequency was similar among those who described themselves as having constipation or diarrhea.⁶ Based on these findings, we assumed that a 7-day chart would be adequate for Indian patients with IBS; we realize that extending the chart to 14 days (or plotting more number of stools) may have increased the likelihood of interpretation, especially on the 18 occasions when interpretation was problematic.

Second, we did not account for single bowel movement with hard or soft stool at the same time. This is a problem the

Table 4 Pearson correlation of diagnosis by Rome III criteria and classification of IBS subtype by fecograph

	BSFS	O1R1	O2R1	O3R1	O1R2	O2R2	O3R2
BSFS	1.0	0.685 (0.000)	0.496 (0.002)	0.475 (0.003)	0.650 (0.000)	0.416 (0.009)	0.476 (0.003)
O1R1	0.685 (0.000)	1	0.792 (0.000)	0.766 (0.000)	0.846 (0.000)	0.618 (0.000)	0.676 (0.000)
O2R1	0.496 (0.002)	0.792 (0.000)	1	0.883 (0.000)	0.666 (0.000)	0.732 (0.000)	0.588 (0.000)
O3R1	0.475 (0.003)	0.766 (0.000)	0.883 (0.000)	1	0.824 (0.000)	0.844 (0.000)	0.760 (0.000)
O1R2	0.650 (0.000)	0.846 (0.000)	0.666 (0.000)	0.824 (0.000)	1	0.767 (0.000)	0.730 (0.000)
O2R2	0.416 (0.009)	0.618 (0.000)	0.732 (0.000)	0.844 (0.000)	0.767 (0.000)	1	0.715 (0.000)
O3R2	0.476 (0.003)	0.676 (0.000)	0.588 (0.000)	0.760 (0.000)	0.730 (0.000)	0.715 (0.000)	1 (0.000)

* $P = 0.01$ (two tailed).

Significance level in brackets.

BSFS, Bristol stool form scale.

fecograph shares with the original BSFS. However, because ours is only a visual display, conceptually, the patient can mark both types on the graph.

Finally, we did not have provision for stating additional symptoms like incomplete evacuation and pain. This can be easily added as check boxes to the fecograph to provide additional information at a glance.

Graphical presentation from data collected in the form of diaries has been used recently for the analysis of data.¹³ It will be worth studying if the patient can directly plot the points on the graph. Plotting data as a scatter plot would also serve the purpose; provision can also be made for adding symptoms as event points. A graph is, however, visually more appropriate for plotting a trend, which is more relevant in IBS than individual stool form.

In conclusion, the newly devised fecograph is a useful and reliable tool to graphically represent stool form for the purpose of subtyping patients with IBS; it may also help separate out patients with the functional pain syndrome. With modification, it can provide information at a glance on associated symptoms, which may further aid in treatment decisions.

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