



Computed Tomography Colonography (CTC): Is It Really the Non-Invasive Option We Think It Is? A Patient Experience Study

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Abstract

Aims: Computed tomography colonography (CTC) is seen as a more tolerable alternative to colonoscopy, but patients struggle with the steps required for optimal diagnostic imaging. This prospective study aims to understand the experience of patients undergoing CTC. **Methods:** A survey was completed by a convenience sample of patients before and after CTC over 7 months. The 13-item questionnaire covered pre-test information, overall and specific experience of the test. The responses were tabulated and analyzed using descriptive statistics. Qualitative free-text responses were coded for content and thematic analysis. **Results:** At a response rate of 51%, surveys were received from 41 patients. Overall, most patients (54%) found the investigation better than expected. However, 18% stated they were not informed of potential side effects. Side effects were experienced by 49% of patients, including diarrhea (34%) and abdominal pain (24%). About 59% experienced discomfort with gas insufflation, and 86% found turning during the investigation difficult. **Conclusion:** A significant proportion of patients undergoing CTC experience side effects and difficulties completing the investigation. Patient information is important to improve patient experience of CTC.

Keywords

imaging, medical decision making, geriatrics, cancer, CT colonography, patient experience, frailty

What Does This Paper add to the Literature?

- With the introduction of straight-to-test CTC and an aging population worldwide, the volume of frail patients being referred direct from primary care will increase. Our study has highlighted the various components of CTC to consider when referring for this test that some patients find difficult.

Introduction

Colorectal cancer is the third most common cancer for both men and women in England (1) and is the second most common cause of cancer-related deaths in the United Kingdom (2). Colonoscopy is the gold-standard investigation for suspected colorectal cancer (3), but computed tomography colonography (CTC), developed in 1994 (4), has now

superseded barium enema as the investigation of choice when colonoscopy is unsuccessful or deemed inappropriate (5).

CTC is a radiological investigation used to identify neoplastic lesions in the colon and rectum. The procedure involves the use of abdominal and pelvic computed tomography (CT), enhanced by the use intra-luminal contrast and gaseous distension. Patients are required to perform repositioning maneuvers in the confined space of a CT scanner in order to obtain optimal prone and supine diagnostic images (6).

Frailty describes an important multifaceted medical syndrome in which individuals experience increased vulnerability to dependency and death due to reduced physiological and physical reserve (7). There are several validated models used

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to screen for frailty, of which the Clinical Frailty Scale, developed by Rockwood et al, provides a simple and rapid assessment tool and is commonly used in the United Kingdom (8). On a scale of 1 (very fit) to 9 (terminally ill), patients who score 5 or higher are considered frail.

CTC has a relative sensitivity to colonoscopy of up to 96% (9) but requires less cathartic preparation (10) and is therefore frequently recommended in frailty, with 25% of patients undergoing CTC being assessed as mild to severely frail (11). It is increasingly recognized that many frail patients struggle with the preparation, gas insufflation, and mobilization required for optimal CTC images.

The demand for CTC investigations has been rising in recent years (12) and direct referral from primary care has been introduced in certain regions of the United Kingdom (13). In addition to this, the COVID-19 pandemic has added pressure to the growing waiting lists of endoscopic and radiological investigations. Appropriate referrals will be vital to help ensure services can address the backlog.

This study aims to better understand the experience and tolerability of patients undergoing CTC in order to better prepare prospective patients and aid clinical decision-making in the investigation of potential colorectal cancer.

Methods

The authors undertook a single-centered, observational cohort study at a large volume tertiary colorectal center. We hypothesized that various aspects of the CTC protocol, aimed at enhancing diagnostic imaging, may have a significant impact on a patient's experience of the investigation.

Survey Tool

A patient experience survey was designed by the authors from the colorectal surgery department, and through collaboration with the trust's patient survey team, was refined to maximize content validity and optimize layout. Following approval for use by the Questionnaire, Interview & Survey Group (QIS), the survey was piloted on 5 patients, and subsequently adapted in consultation with the department of radiology to improve useability. The 13-item survey consisted of 2 Likert scales, 10 discrete questions and the option to expand in 4 free-text boxes and was accompanied by a cover letter. It was designed to investigate various aspects of the patient's experience, including the quality of the pre-test information, overall and specific experience of the test including side effects, discomfort from gas insufflation and difficulty performing the required maneuvers. The full survey is available in Figure 1.

Patient Sampling and Data Collection

All patients who underwent a CTC at the radiology department were eligible to participate in this study. This cohort included patients referred from the outpatient departments, inpatient admissions and direct referrals from primary care.

Indications for the investigation included: clinical suspicion of colorectal malignancy where patients were deemed unsuitable for colonoscopy, failed colonoscopy and surveillance imaging of previously identified colorectal pathology. A convenience sample of 41 patients was obtained over a 7-month period. There was an interruption of 12 weeks due to the COVID-19 pandemic, where scanning and data collection was suspended, before the radiology department restarted at a reduced operating capacity.

Patients were invited to participate in the study upon checking into the department. They were then provided with an information leaflet and verbally consented by the radiographer for their anonymous participation in the study. Responses were completed before and after the procedure and collected in a designated box.

CTC Protocol

At 2 days before the scan, patients were instructed to eat a low-fiber diet up until and including lunch time. After this, they were permitted a soft food diet. On the day of the scan, patients could drink clear fluids only. Patients were asked to drink 2 50 mL doses of Gastrograffin® (Bracco Diagnostics Inc.) in the 2 evenings prior to the scan. Intravenous hyoscine butylbromide was administered prior to gas insufflation. An automated carbon dioxide insufflator was used to achieve maximal pressures tolerated by patients. Two positions were used in the scanning protocol: prone and supine, and images were captured on inspiration.

Statistical Analysis


The frequency of responses per question was tabulated and analyzed using descriptive statistics. Questions were analyzed individually, using a denominator equivalent to the total number of fully completed responses. Some results were grouped to aid interpretation of scaled responses. Qualitative free-text responses were coded for content and thematic analysis (14).

Results

There was a response rate of 51%. There were no major complications or unplanned admissions following CTC. Full results are shown in Table 1.

Quantitative

Overall, the majority of patients (54%) found the investigation better than expected and 100% felt their dignity was maintained. However, 51% reported some form of side effect. Over a third (38%) of these experienced diarrhea from the contrast drink, of which 5 (14%) was severe. Abdominal pain (27%), followed by nausea (16%), were the next most common side effects associated with the scan (Figure 2).



Patient Experience questionnaire – CT colonography

We are carrying out a survey to check that our patients are receiving a good service from the Colorectal team.

We would be very grateful if you could complete the attached questionnaire about your experience today and return it to the box on the reception desk.

Participation in this survey is voluntary and will not affect your care or treatment. Any answers you give will be treated in the strictest confidence.

If you have any questions about this survey please speak to a member of staff or email greg.dewar@uhbristol.nhs.uk.

Thank you for your time.

*The Colorectal Team
Greg Dewar*

Before having the CT colonography

1. When you were referred to have a CT colonography, were you told why you needed this procedure?
 Yes, completely Yes, to some extent No Can't remember

2. Before you came to the scanning department today, did you receive any written information about the CT colonography?
 Yes (please go to question 3)
 No (please go to question 4)
 Can't remember (please go to question 4)

3. Did you find this written information helpful?
 Yes, definitely Yes, to some extent No Can't remember

3a. If you answered "Yes, to some extent" or "No" to question 3, please can you tell us how we could have made this information more helpful:

4. Before you had the CT colonography today, were the following things explained to you by the clinician that referred you for the test:

	Yes, completely	Yes, to some extent	No	Can't remember
What would happen during the procedure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The risks and benefits of the procedure	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
When and how to drink the dye / contrast	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
The possible side effects of the dye / contrast	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

1

5. Overall, do you feel that you were provided with all of the information you needed before having the CT colonography?
 Yes No Not sure

5a. If you answered "No" to question 5, please can you tell us what additional information would have been helpful:

Your experience of the procedure

6. Did you experience any side effects from drinking the dye / contrast liquid?
 Yes (please go to question 7)
 No (please go to question 8)

7. Which of the following side effects did you experience? (Please tick all that apply)
 Mild diarrhoea Severe diarrhoea
 Bad taste Stomach pain
 Nausea or sickness Something else (please write in)

8. Overall, was the experience of having the CT colonography:
 Better than you expected Worse than you expected
 About what you expected Not sure

8a. If your experience of the procedure was worse than you expected, please can you tell us the main reason(s) for this:

2

9. On a scale of 1 to 5, how did you find the following aspects of the CT colonography:

	1 – not at all uncomfortable	2	3	4	5 – extremely uncomfortable
Inserting the tube	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Administering gas into your colon	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Removing the tube	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

10. Did you find it difficult to do the turning manoeuvres in the scanner?
 Yes, definitely Yes, to some extent No

11. Do you feel the team did everything they could to maintain your dignity?
 Yes, definitely Yes, to some extent No

12. Were you told how and when the results of the CT colonography would be communicated to you?
 Yes No

13. Do you have any comments about your experience of the CT colonography service (e.g. aspects of the service that were good / anything that could be improved)?

Thank you.

Please return your completed questionnaire to the box at the reception desk labelled "CT colonography Questionnaire"

3

Figure 1. Patient experience survey.

Around half of patients found the tube insertion uncomfortable (43%), and 59% experienced discomfort from the gas insufflation itself. None rated this discomfort extreme, but 50% rated it at a level 2 to 3 out of 5, and 9% 4 out of 5 in severity. Removing the tube was felt to be uncomfortable in only 37% of cases (Figure 3). Regarding mobility issues, 86% had any degree of difficulty performing the turning maneuvers in the scanner, of whom 59% had significant difficulty.

About 97% understood the indication for this test and 95% found their written information helpful. Despite this, 8% felt they were not told what would happen during the procedure, 11% felt they were not informed of the risks and benefits, 9% did not know how to take the contrast dye and 18% were not aware of its potential side effects. Regarding follow-up, 31% were unsure how and when their results would be communicated to them.

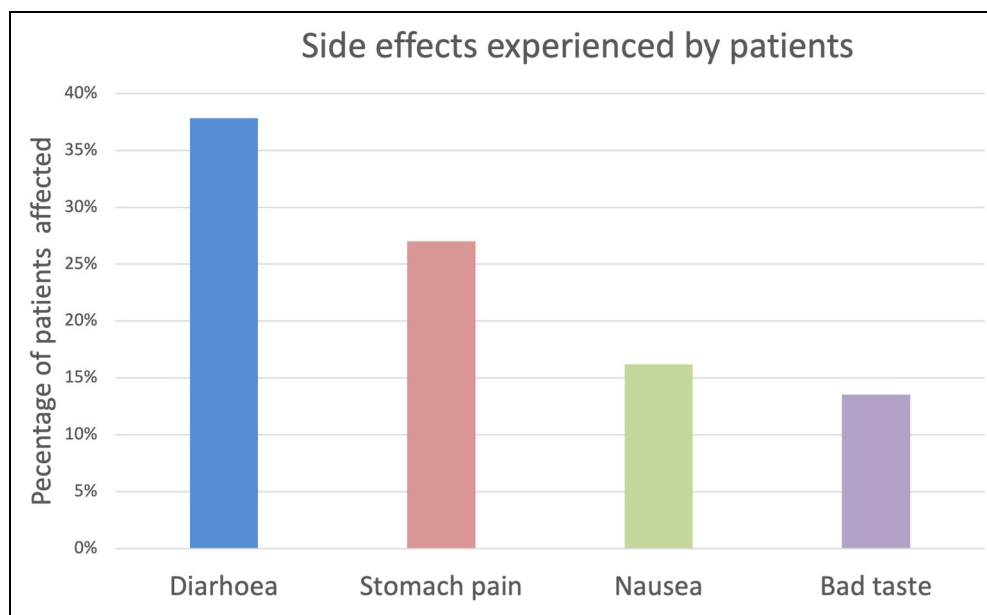
Table 1. Questionnaire Results.

	Total	%	n =
Were you told why you needed the procedure?			
Yes completely	30	77	39
Yes to some extent	8	21	39
No	0	0	39
Can't remember	1	3	39
Did you receive written information?			
Yes	36	92	39
No	3	8	39
Can't remember	0	0	39
Did you find this written information helpful?			
Yes definitely	35	95	37
Yes to some extent	2	5	37
No	0	0	37
Can't remember	0	0	37
Explanation of procedure?			
Yes completely	29	76	38
Yes to some extent	4	11	38
No	3	8	38
Can't remember	2	5	38
Explanation of risks/benefits?			
Yes completely	25	66	38
Yes to some extent	8	21	38
No	4	11	38
Can't remember	1	3	38
Explanation of how to take contrast?			
Yes completely	29	83	35
Yes to some extent	2	6	35
No	3	9	35
Can't remember	1	3	35
Explanation of dye side effects?			
Yes completely	21	64	33
Yes to some extent	4	12	33
No	6	18	33
Can't remember	2	6	33
Did you have all the information needed?			
Yes	37	95	39
No	1	3	39
Not sure	1	3	39
Side effects experienced?			
Yes	19	51	37
No	18	49	37
Side effects:			
Mild diarrhea	9	24	37
Bad taste	5	14	37
Nausea	6	16	37
Severe diarrhea	5	14	37
Stomach pain	10	27	37
Other:	4	11	37
<i>Any amount of diarrhea</i>	14	38	37
	Total	%	n =
Experience:			
Better than expected	21	54	39
About same as expected	17	44	39
Worse than expected	0	0	39
Not sure	1	3	39
Discomfort inserting tube			
No discomfort	20	57	35

(continued)

Table 1. (continued)

	Total	%	n =
Discomfort 2/5	8	23	35
Discomfort 3/5	7	20	35
Discomfort 4/5	0	0	35
Extreme discomfort 5/5	0	0	35
<i>Any degree of discomfort</i>	15	43	35
Discomfort with gas insufflation			
No discomfort	14	41	34
Discomfort 2/5	7	21	34
Discomfort 3/5	10	29	34
Discomfort 4/5	3	9	34
Extreme discomfort 5/5	0	0	34
<i>Any degree of discomfort</i>	20	59	34
Discomfort removing tube			
No discomfort	22	63	35
Discomfort 2/5	8	23	35
Discomfort 3/5	5	14	35
Discomfort 4/5	0	0	35
Extreme discomfort 5/5	0	0	35
<i>Any degree of discomfort</i>	13	37	35
Turning difficulty			
Yes	22	59	37
Yes to some extent	10	27	37
No difficulty	5	14	37
<i>Any degree of difficulty</i>	32	86	37
Was your dignity maintained?			
Yes definitely	34	92	37
Yes to some extent	3	8	37
No	0	0	37
Communication of results?			
Yes	24	69	35
No	11	31	35

**Figure 2.** Side effects.

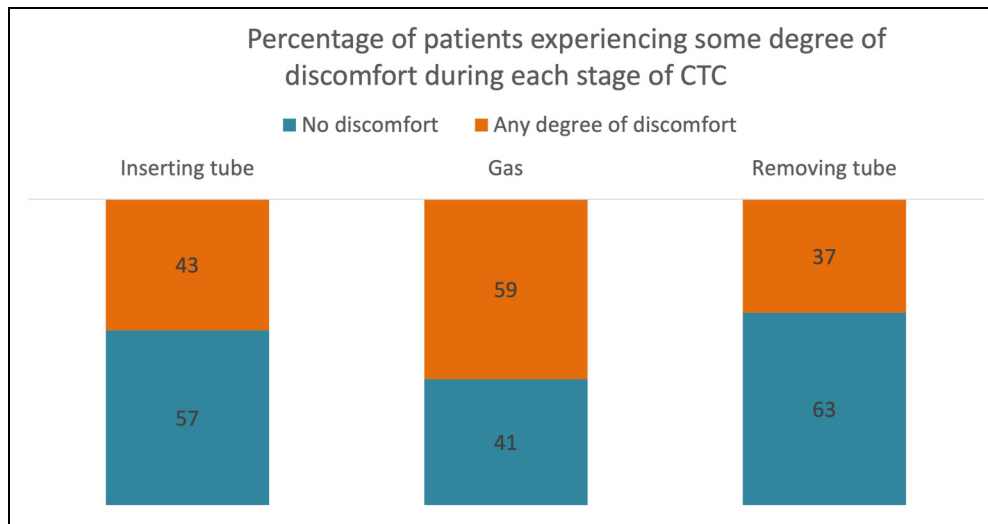


Figure 3. Patient discomfort.

Free Text Responses

The majority of free-text responses were shared in the final comments section. The 4 main themes identified reflect the relative importance of aspects identified from the quantitative results.

Information giving. The degree to which patients felt informed had an influence on their overall experience, with some feeling empowered: “they explained everything,” while others felt they were “given vague instructions.”

Feeling at ease. Reflecting the high reporting of dignity maintenance, patients valued the “considerate and friendly team,” who were “helpful and caring” and allowed patients to feel “able to relax.”

Physical difficulties. Some of those who struggled in the procedure chose to elaborate further, providing reasoning for their difficulties: “being a bigger lady” and describing their “difficulty turning due to back problems.” Some chose to offer suggestions, including “maybe some grab handles.”

Very good service. Some felt they “need not have worried,” finding the overall experience positive. Practical elements including having their “appointment on time” was highly valued.

Discussion and Conclusions

CTC's use in Frail Populations

In a review completed in our center (9), 25% of patients with a documented Rockwood frailty score undergoing CTC were mild-severely frail. CTC provided a definitive diagnosis in 79% of cases, however 31% of the 306 patients required further investigation with endoscopy to either confirm or rule out a suspicion on the CTC. About 18% of those requiring further investigation had a Rockwood score of 5 or over.

With the introduction of straight-to-test CTC (13) and an aging population worldwide (15), the volume of frail patients being referred direct from primary care will increase. Previous studies have shown good overall tolerability of CTC (16), but our study has highlighted the various components of the test that some patients find difficult which is important for clinicians to consider when referring for CTC.

Whilst protocols for CTCs differ between units, our study has illustrated issues related to different aspects of the preparation and procedure.

Preparation

Fecal tagging is a fundamental stage in all CTC protocols and although supplemental cathartic bowel preparation is no longer used in many centers, the gastrointestinal effects of agents such as Gastrografin® are often neglected. Our study has found that Gastrografin® produced a number of frequently reported side effects including abdominal pain and diarrhea. Previous studies have not shown any significant biochemical abnormality (17) caused by fecal tagging agents, however clinicians may need to be aware of the potential risk dehydration may cause to those with reduced renal functions or significant comorbidities.

Emphasis should be placed by the clinical team during the consenting process on the potential effects of fecal tagging agents. Frailty may affect the patient's ability to mobilize to the toilet or administer analgesia when required and practical preparations may need to be made in their home in the period prior to the test, for example extra support or a commode. Whilst minimal preparation CTC protocols have been developed which provide an overall more tolerable investigation (18), it does not entirely prevent potentially significant patient distress.

Scanning Protocol

Adequate colonic distension is important in achieving good quality diagnostic imaging, with one study finding a

reduction in false positive rates from 15% to 5% (19) and reduced scanning time (20). Other methods of achieving colonic distension, used in varying combinations, include turning maneuvers and the use of antispasmodic agents, although evidence for the use of the latter is weak (20), and many minimally invasive CTC protocols do not recommend their use.

A significant proportion of our patient population experienced discomfort with the overall use of gas, however the majority of these found the discomfort moderate. We are also unable to draw any direct conclusions regarding the impact of this discomfort on the patients' overall experience and tolerability.

A significant proportion of our patient population struggled manoeuvring during the investigation, with patients reporting increased body habitus and pre-existing back pain as contributing factors.

Patients with restricted mobility, not otherwise deemed frail, referred for CTC following a failed colonoscopy due to this reason, should be assessed for their ability to complete the required turning maneuvers in the CT scanner. Using a combination of 2 scanning positions has been shown to increase the quality of colonographic imaging (21), although, for those less mobile, it has been suggested this could be using a combination of supine-left decubitus as an alternative to supine-prone, while still achieving adequate test sensitivity.

The issues raised in this study, combined with the fact CTCs are time consuming to perform and report, means other imaging strategies may need to be considered, particularly in the context of rising demand. Alternatives include:

1. Non-Colonography CT

For patients deemed unsuitable for surgical or oncological intervention but where diagnostic information will be aid in advanced and supportive care planning, intravenous contrast-enhanced CT (IVCT) without specialist colonographic protocols can be considered. IVCT has been demonstrated to have a sensitivity of 72.4% for the detection of invasive colorectal cancers but a low sensitivity for polyp detection (10.1%) (22). The inferiority of IVCT should be considered in the context of the patient and that progression from adenoma to adenocarcinoma may take 5 to 8 years (23). If IVCT is used to exclude malignancy, the negative predictive value for invasive colorectal malignancy of 78.9% to 100% (22,24). IVCT can be performed without the need for oral contrast, gas insufflation or patient turning and the scan itself requires less time in the scanner and radiologist reporting time.

CTC is clearly the superior investigation to IVCT in the identification of polyps and colorectal malignancy however for patients in whom invasive investigation or treatment would be intolerable, IVCT could provide adequate prognostic information regarding significant or extensive disease or metastasis. As such, evaluation of the clinical significance

of test characteristics in relation to patient-specific needs and involving patients in these discussions will aid in clinical decision-making (25).

2. Patient Tailored CTC Protocols

The number of minimally invasive imaging technique protocols has increased globally in recent years (26). Further evaluation of how frailty affects the tolerance of each aspect of CTC is required in order to develop individualized patient tailored CTC protocols. This could allow us to balance patient experience with adequate diagnostic outcomes.

The data collected in this study contributes to a growing pool of information that referring clinicians can use to prepare and select patients for our current CTC protocols.

Limitations

The study was carried out at a single center and has a relatively small sample size. It should be considered, therefore, that this study may not have captured all experiences of patients undergoing CTC. The volume of patients recruited into the study was restricted, in part, due to the disruption caused by the COVID-19 pandemic that came into effect halfway through data collection. It is also important to consider that the restrictions imposed and anxiety around the virus transmission may have changed the demographics of patients seen in clinic and attending for outpatient investigations. Due to the relatively greater risk of the virus to older populations, our study group may have under-represented those considered more frail. Supplementation with results from a larger study will help to validate the findings presented in this paper. The requirement for personal protective equipment and non-touch interactions with reception staff may also have influenced patient experience but did not disrupt the CTC protocol used in the center.

Author Contribution

All authors contributed to the study design, analysis, and write-up. In addition, GD and BB completed data collection. GD and BB co-authored the manuscript submitted.

Declaration of Conflicting Interests

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Statement of Human and Animal Rights

This article does not contain any studies with human or animal subjects.

Statement of Informed Consent

Verbal informed consent was obtained from the patient(s) for their anonymised information to be published in this article.

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