Experiences of CT Colonography With Fecal Tagging Method in Children—Initial Results—

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Abstract

Purpose: The purpose of this study was to assess the feasibility of CT colonography (CTC) using the fecal tagging method in children and tagging performance.

Methods: A total of 11 outpatient patients were subjected to this study. All patients underwent bowel preparation using amidotrizonic acid at a dose of 0.8 ± 0.1 ml/kg/day for three days prior to CTC. After colonic air insufflations, CT was scanned in both supine and prone position. In six colon segments and between different patients, the degree of fecal tagging was evaluated and graded in six point scale by two independent radiologists.

Results: All studies were performed without any complications. All patients needed no sedatives. Tagging performance was "good" or "moderate" in 86% of evaluated residual segments.

Conclusion: In conclusion, CTC with fecal tagging method is safe and feasible in children.

Key words: CT colonography, children, fecal tagging

I Introduction

Rectal bleeding is not rare in children. Juvenile inflammatory polyps are the most common cause of rectal bleeding in children[1]. Low volume rectal bleeding, whether it is intermittent or continuous, may be caused by colorectal polyps. Generally, double contrast barium enemas and conventional colonoscopy are often performed for diagnosis. Although contrast barium enemas are useful for diagnosing colorectal polyps, they are uncomfortable and involve radiation exposure. Conventional colonoscopy is the reference standard total colorectal examination, but it is technically demanding and invasive, and conventional colonoscopy usually requires sedatives or general anesthesia in children. Advances in helical CT have made it a useful diagnostic tool for colorectal lesions. CT colonography (CTC) is a new technique for examining the colon and rectum using helical abdominal CT scanning. CTC is now widely accepted as a new modality for screening for colorectal cancer and polyps in adult. However, only a
few authors have described the use of CTC in children\(^2\)\(^-\)\(^4\).

We have reported the feasibility of single scan CTC using polyethylene glycol electrolyte solution with contrast medium (PEG-C) for bowel preparation\(^2\). The single scan CTC with PEG-C preparation was safe and well tolerated in children and less invasive than conventional CTC due to the shorter examination time and lower radiation dose. However, intensive cathartic preparation is uncomfortable and inconvenient\(^5\). In addition, in our institute, patients undergoing cathartic preparation need hospitalization.

In recent years, fecal tagging with contrast medium has become a widely used, new bowel preparation technique for CTC in adults\(^6\)\(^-\)\(^11\). The fecal tagging method needs no or less cathartic preparation. Hoping to make CTC a less demanding examination, the present study aimed to evaluate tagging performance and pediatric patient's acceptance of non-cathartic preparation with fecal tagging.

II Materials and Methods

From December 2007 to June 2009, an outpatient population scheduled for a colorectal investigation was invited to undergo CTC with fecal tagging. The pediatric surgeon informed all parents regarding the procedure and the complications of CTC. The indication was a suspected elevated lesion of the colorectum. Exclusion criteria were inflammatory bowel disease, age less than one year, allergy, and risk of aspiration.

The preparation prior to CTC consisted of a combination of a small amount of contrast agent and a glycerin enema. Amidotrizonic acid (Gastrografin\textsuperscript{®}, Bayer Schering Pharma, Osaka, Japan) was used as a water-soluble contrast medium for fecal tagging. For three days prior to CTC, patients were asked to take 1 ml/kg/day of the contrast agent before each meal (maximum 15 ml/day). They were otherwise not asked to change their diet. Then, patients had a glycerine enema the day before CTC and before coming to hospital (Fig. 1).

A 24-Fr Foley catheter was placed in the rectum, and the balloon was inflated just before the investigation. Room air was insufflated into the colon through the catheter with a pediatric blood pressure manometer in the left decubitus position. The upper limit of insufflation pressure was 20 mmHg. We could feel the air insufflations into the cecum at the right lower quadrant of abdomen in every case. Then, the whole abdomen was scanned from the diaphragmatic vault to the pubis. CT scanning was done in both the supine and prone positions. Neither glucagon nor butylscopolamine bromide was administered.

The study was performed using a 64-detector row CT scanner (Aquilion 64; Toshiba, Tokyo, Japan). The following scanning protocol was used: 32×1 mm collimation; pitch, 29:0; gantry rotation time, 0.5 s; reconstruction width, 1.00 mm at an interval of 0.8 mm; 120 kVp; and 50–300 mA.

The colon was surveyed using 2-dimensional multiplanar reformation (MPR) images. Then, 3D images were reconstructed with a workstation (ZIO M900, Zio Software, Tokyo, Japan).

To quantify the effectiveness of fecal tagging, a scoring system was established. The colorectum was examined and scored in six segments (cecum, ascending colon, transverse colon, descending colon, sigmoid colon, and rectum). Each segment of the colorectum was given a visual subjective score of 6-point scale (0 = no contrast in stool, 5 = fully impregnated stool) by two independent radiologists. The scores were classified into three classes: "poor" (0 and 1), "moderate" (2 and 3), and "good" (4 and 5). If multiple feces were located in one segment, the minimum score was adopted as the scale. When scores of one segment by the same observer were different with the position (prone or supine), the

![Fig. 1 Plot shows the schedule for oral administration of Gastrografin\textsuperscript{®} (1 ml/kg/day, maximum 15 ml/day) and the use of glycerine enema prior to CT colonography.](image-url)
maximum score was adopted. And if no feces located in one segment, the score of the segment was not evaluated.

### III Results

Eleven patients who agreed to take part were included in the study. Indications were anal bleeding \((n=8)\), change in the stool habit \((n=2)\), and suspected rectal prolapse \((n=1)\) (Table 1). The patients' mean age was 58 months, and their mean body weight was 17.4 kg. The amount of orally administered amidotrizionic acid was \(0.8 \pm 0.1\) ml/kgBW/day. All studies were performed without any complications. No patients needed sedatives. Every study had finished within 10 min.

Concerning the fecal tagging, the feces were tagged with orally administered contrast medium (Fig. 2). Diagnosis of rectal polyp was possible in case 11 (Fig. 3).

In a total of 66 segments, residual feces were evaluated in 46 (observer 1) and 51 (observer 2) segments, respectively. The mean number of segments that was evaluated was 7.5 (68%) in the cecum, 10.5 (96%) in the ascending colon, 9 (82%) in the transverse colon, 6.5 (59%) in the descending colon, 8 (73%) in the sigmoid colon, and 7 (64%) in the rectum.

Of all 97 scores, 71 (73%) were "good", 13 (13%) were "moderate", and 13 (13%) were "poor". The average scores over all patients per segment ranged from 3.90 ± 0.83 (ascending colon) to 4.83 ± 0.37 (descending colon).

### Table 1 Clinical and radiological findings in eleven children.

<table>
<thead>
<tr>
<th>Case</th>
<th>Age</th>
<th>Sex</th>
<th>BW(kg)</th>
<th>Presenting complaint</th>
<th>CTC findings</th>
<th>Colonoscopy findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 years and 3 months</td>
<td>F</td>
<td>11</td>
<td>anal bleeding</td>
<td>normal findings</td>
<td>normal findings</td>
</tr>
<tr>
<td>2</td>
<td>3 years and 0 month</td>
<td>F</td>
<td>11</td>
<td>change in the stool habit</td>
<td>normal findings</td>
<td>NA</td>
</tr>
<tr>
<td>3</td>
<td>8 years and 2 months</td>
<td>F</td>
<td>24</td>
<td>change in the stool habit</td>
<td>normal findings</td>
<td>normal findings</td>
</tr>
<tr>
<td>4</td>
<td>3 years and 4 months</td>
<td>M</td>
<td>13</td>
<td>anal bleeding</td>
<td>normal findings</td>
<td>normal findings</td>
</tr>
<tr>
<td>5</td>
<td>6 years and 8 months</td>
<td>F</td>
<td>19</td>
<td>anal bleeding</td>
<td>normal findings</td>
<td>NA</td>
</tr>
<tr>
<td>6</td>
<td>5 years and 1 month</td>
<td>F</td>
<td>16</td>
<td>rectal prolapse</td>
<td>normal findings</td>
<td>normal findings</td>
</tr>
<tr>
<td>7</td>
<td>2 years and 10 months</td>
<td>M</td>
<td>14</td>
<td>anal bleeding</td>
<td>normal findings</td>
<td>NA</td>
</tr>
<tr>
<td>8</td>
<td>5 years and 11 months</td>
<td>M</td>
<td>20</td>
<td>anal bleeding</td>
<td>normal findings</td>
<td>normal findings</td>
</tr>
<tr>
<td>9</td>
<td>6 years and 6 months</td>
<td>M</td>
<td>27</td>
<td>anal bleeding</td>
<td>normal findings</td>
<td>NA</td>
</tr>
<tr>
<td>10</td>
<td>6 years and 2 months</td>
<td>M</td>
<td>22</td>
<td>anal bleeding</td>
<td>normal findings</td>
<td>normal findings</td>
</tr>
<tr>
<td>11</td>
<td>3 years and 6 months</td>
<td>M</td>
<td>14</td>
<td>anal bleeding</td>
<td>rectal polyp</td>
<td>(transanal polypectomy)</td>
</tr>
</tbody>
</table>

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Fig. 4  Average scores over all patients per segment for both observers.


scending colon) for observer 1. and from 2.72 ± 1.91 (ascending colon) to 4.42 ± 1.39 (descending colon and rectum) for observer 2 (Fig. 4).

The frequency of "good" scores was 53% in the cecum, 47% in the ascending colon, 88% in the transverse colon, 92% in the descending colon, 87% in the sigmoid colon, and 78% in the rectum. The cecum and ascending colon were less frequently rated "good" than the other segments.

IV Discussion

Since colorectal polyps are not rare in the pediatric population, colorectal investigations are often required. Although double contrast barium enema and/or conventional colonoscopy are thought to be the optimal examinations, bowel preparation and the examinations themselves are associated with discomfort. They require thorough bowel preparation with cleansing and a laxative, because fecal residues may obscure underlying polyps.

CTC was introduced as a less invasive colorectal examination and has been widely accepted in adults\textsuperscript{12}. CTC can have advantages in preparation, discomfort, and examination time. In adults, CTC with bowel cleansing has become commonly used. Bowel cleansing is usually performed by medical and/or physical means, and it is known as "wet preparation". However, such intensive bowel preparation is uncomfortable, inconvenient, and a negative factor in patient acceptance\textsuperscript{5}. We have reported the feasibility of CTC with PEG-C preparation in children\textsuperscript{2}. However, the administration of PEG may be difficult in children, and they need hospitalization for preparation in our institute (Table 2).

To make CTC a more comfortable investigation, the fecal tagging method was introduced\textsuperscript{6-11}. Fecal tagging consists of oral administration of contrast medium with or without dietary restrictions. The contrast medium accumulates in the feces. Well-tagged fecal contents may allow differentiation of residual stool, intestinal mucosa, and polyps. Fecal tagging is now a preferred method, but the choice of contrast agent for fecal tagging should be based on local experience with regard given to any history of allergy\textsuperscript{12}. Generally, fecal tagging has been performed with barium or a water-soluble agent. Several studies with ionic or non-ionic iodinated water-soluble agents for fecal tagging have been reported in adults\textsuperscript{6,13}. Fecal tagging with water-soluble agents needs less amount of contrast medium compared with fecal tagging with barium, and resulted in excellent contrast-impregnated stool\textsuperscript{7-10}. In the present study, fecal tagging was performed with a water-soluble iodinated contrast medium because we have previously used amidotrizonic acid for CTC. With ionic iodinated agents, adverse reactions (diarrhea, nausea, vomiting, itching, urticaria) can occur. Patients and their parents were informed about these reactions. In this series and in our previous series, no adverse reactions occurred. All patients tolerated these agents. Although the addition of a laxative to fecal tagging may enhance the detection of polyps\textsuperscript{14}, it may cause discomfort in children. Therefore, we asked patients to ingest contrast medium for three days prior to CTC, in contrast to usual fecal tagging, which is performed for less than two days prior to CTC. We also added glycerin enemas to fecal tagging instead of the laxative.

In the present series, the patients were not asked to change their dietary habits. Theoretically, dietary restriction may be useful for fecal tagging. However, dietary restriction as previously reported is difficult for children. It may be uncomfortable and inconvenient for patients and their parents.

Although the present patients were so young that use of a questionnaire would be difficult, all parents were satisfied with this preparation. With regard to patient
Table 2 Comparison between our "fecal tagging method" with "PEG-C method\textsuperscript{25}.

<table>
<thead>
<tr>
<th></th>
<th>Fecal tagging method</th>
<th>PEG-C method\textsuperscript{25}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composition</td>
<td>Tagged feces + air</td>
<td>PEG-C + air</td>
</tr>
<tr>
<td>Preparation</td>
<td>Small amount of water soluble contrast agent</td>
<td>PEG-C</td>
</tr>
<tr>
<td>Dietary restriction</td>
<td>Unnecessary</td>
<td>Necessary</td>
</tr>
<tr>
<td>Scanning</td>
<td>Supine + prone</td>
<td>Supine</td>
</tr>
<tr>
<td>Hospitalization</td>
<td>Unnecessary</td>
<td>Necessary</td>
</tr>
<tr>
<td>Sedation</td>
<td>Unnecessary</td>
<td>Almost unnecessary</td>
</tr>
<tr>
<td>Side effect</td>
<td>Not observed</td>
<td>Not observed</td>
</tr>
</tbody>
</table>

PEG-C: polyethylene glycol electrolyte solution with contrast medium.

acceptance, no patient needed sedatives.

Tagging was acceptable in all patients. Previous studies on CTC with the fecal tagging method in adults found that the results in the rectum were not as good\textsuperscript{7,9}. In contrast, in the present series, results in the rectum were good. This difference may due to the glycerin enemas.

Radiation exposure is of great interest, especially in children. In the present series, scans were obtained in both the supine and prone acquisitions. This approach was effective for distinguishing between residual stools and colonic wall or polyps. Although available data are small \((n=4)\), radiation exposure is \(15.7 \pm 5.0 \text{ mGy (volume computed tomography dose index; CTDI volume)}\). In our previous series, radiation exposure was \(9.1 \pm 2.8 \text{ mGy (CTDI volume)}\) in single scan CTC. We think that this radiation dose is permissible, and this method was appropriate. In both the prone and supine positions, the patients were cooperative.

Low-dose CT colonography has been previously reported in children\textsuperscript{4}. However, with the fecal tagging method without laxatives, too low a radiation dose should be avoided, because oral contrast agents (barium or iodine-containing medium) tend to increase noise and streak artifacts\textsuperscript{15}. In the present series, the radiation dose was not so low. Further investigation should be performed on the correlation between radiation dose and artifacts with the fecal tagging method in children.

CTC also allows visualization of organs outside the colon. Previous studies focused on extracolonic findings and reported extracolonic findings in 33-69% of adult patients\textsuperscript{16-19}. Finding extracolonic lesions may potentially have positive and negative aspects. On the positive side, though it may be rare in children, serious asymptomatic disease can be found earlier. On the negative side, the findings may lead to further unnecessary and costly investigations that have the potential to increase patient morbidity. In the present series, there were no extracolonic findings. The difference in incidence may arise from the difference in the population and age. CTC can be beneficial for some types of asymptomatic extracolonic findings, such as adrenal masses and ovarian cysts, even in children. However, there is a limitation in finding extracolonic lesions, since low-dose radiation can be used in CTC due to the high contrast between air and colonic wall. Hara et al. pointed out that low attenuating lesions in solid organs can be overlooked when using low-radiation dose techniques\textsuperscript{16}.

The sensitivity and specificity of CTC for detecting polyps larger than 5 mm have been reported to be high\textsuperscript{12}. In children, Capuñay et al. reported sensitivity of 90% and specificity of 90% for polyps larger than 5 mm\textsuperscript{3}. With fecal tagging, Iannaccone et al. found sensitivity of 100% for polyps larger than 8 mm and 86% for polyps larger than 6 mm in adults\textsuperscript{10}. They emphasized the high negative predictive value (93.5%) of CTC with fecal tagging.

Although radiation exposure of "CTC with fecal tagging method" is higher than "single scan CTC with PEG-C preparation", preparation itself is less invasive. In conclusion, CTC with fecal tagging is feasible in children. However, further investigations are needed to evaluate the sensitivity and specificity of CTC with fecal tagging in children with colorectal polyps.

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References


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