Evaluation of colonic dilatation with and without the use of antispasmodics and effects of patient size in CT colonography

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Purpose

As multislice CT emerged, CT colonography (CTC) became capable of acquiring high-resolution images of a broad area within a short period of time, and advancement in image processing techniques facilitated studies on its application for screening mainly in Western countries 1)2)3)4).

In Japan, a combination of the fecal occult test and endoscopy of the whole large intestine is recommended for screening, and there has been no report on the usefulness of screening using CTC.

Several conditions are required to maintain the high-level accuracy of screening employing CTC, such as appropriate pretreatment, optimizing acquisition conditions, and fecal tagging, and favorable dilatation of the intestinal lumen is also an important factor. Insufficient colonic dilatation reduces the ability to observe lesions, leading to them being overlooked.

In this study, we paid attention to the use of antispasmodics as a factor which influences colonic dilatation on CTC, and compared colonic dilatation with and without the use of antispasmodics. Since, based on our experience, a patient's body size is associated with the degree of colonic dilatation, we also evaluated colonic dilatation by body size. In addition, changes in colonic dilatation due to differences in the gas infusion pressure of an automated carbon dioxide delivery system were also investigated.
Methods and Materials

The subjects (96 males and 61 females) were randomly selected from 294 examinees who underwent CTC for screening between April and October 2009.

Comparison of colonic dilatation with and without the use of antispasmodics

The subjects were divided into 43 treated with intramuscular injection of an antispasmodic (timepidium bromide: SEDEN® injection 7.5 mg, Tanabemitsuishi, Osaka, Japan) (treated group) and others who could not be treated with antispasmodics due to glaucoma and heart disease (untreated group). The treated group consisted of 34 males and 9 females aged 50.3±11.9 (mean±SD) years, and the untreated group comprised 30 males and 10 females aged 61.3±10.7 years. The gas infusion pressure was set at 20 mmHg in both groups.

Evaluation of colonic dilatation by body size

The body mass index (BMI) was used as an index of a subject's body size. For uniform test conditions, only 117 subjects with antispasmodic treatment were included, and 43 subjects without treatment were excluded. The subjects were divided into 3 groups based on the BMI: those with a BMI lower than 20, between 20 and 25, and 25 or higher. The subjects were further divided into 2 groups based on the gas infusion pressure: 20 and 23 mmHg. The 20 mmHg group consisted of 11 subjects with a BMI lower than 20, 17 with a BMI between 20 and 25, and 15 with a BMI of 25 or higher, and the 23 mm Hg group consisted of 15, 32, and 27 subjects, respectively (Table 1 on page 5). The influence of body size (BMI) on colonic dilatation was investigated by the gas infusion pressure.

Acquisition method and conditions

For pretreatment before CTC, intestinal lavage solution (polyethylene glycol, 2 L) was applied referring to that in endoscopy in all subjects. The system used was 64-row multislice CT (Aquillion 64, Toshiba, Tokyo, Japan), and a workstation, ZIO station system N610 (Version 1.21b) (Amin, Tokyo, Japan) was used for analysis. The tube voltage was 120 kV, the tube current was 100 mA, and the gantry rotation speed was 0.5 sec. The collimation used was 0.5 mm x 64 in all subjects, the helical pitch was 0.83, and the table speed was 27 mm per rotation. The subject lay on the table in a left lateral position and received intramuscular antispasmodic administration 10 minutes before examination to inhibit intestinal peristalsis. After checking for the presence or absence of an anal lesion by rectal examination, a 12-Fr nelaton catheter for gas delivery was inserted into the anus. The subject lay in a left lateral or supine position during gas delivery, and carbon dioxide was delivered at 20 or 23 mmHg using an automated delivery system equipped with a pressure measurement function (Nemoto Kyorindo, Tokyo,
After confirming sufficient colonic dilatation in a scout view, images were acquired while breath-holding (expiration) in prone and supine positions. The acquisition area was the subdiaphragmatic region over the inferior margin of the pubes in both positions, and cephalocaudal images were acquired during breath-holding for 7-10 seconds. The obtained helical data were subjected to image reconstruction at a 0.5-mm slice thickness and 0.5-mm intervals (900-1000 images), and transmitted to the workstation.

Visual evaluation of colonic dilatation

The acquired image data were transmitted to the workstation and selected for examination, followed by the preparation of 3-dimensional air images employing volume rendering. The large intestine was divided into 5 segments (ascending colon: A, transverse colon: T, descending colon: D, sigmoid colon: S, and rectum: R). Five radiotechnologists and one radiologist assessed the degree of colonic dilatation in the segments and subjects in prone and supine positions using the 3-dimensional air images. The degree of colonic dilatation was given a score of 1-5: Score 1: the whole or nearly whole region was obstructed, score 2: partially interrupted, score 3: dilatation was insufficient, score 4: dilatation was not problematic, and score 5: dilatation was sufficient (Fig. 1 on page 5).

For statistical analysis, the Mann Whitney-U and Kruskal-Wallis tests were employed, and a p-value of less than 0.05 was regarded as significant.
Table 1. Number of subjects in BMI and gas infusion pressure categories

<table>
<thead>
<tr>
<th></th>
<th>BMI value Less than 20</th>
<th>BMI value Between 20 and 25</th>
<th>BMI value 25 or greater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gas infusion pressure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 mmHg group</td>
<td>11 (6 males, 5 females)</td>
<td>17 (15 males, 2 females)</td>
<td>15 (13 males, 2 females)</td>
</tr>
<tr>
<td></td>
<td>(47.8 ± 15.6 yrs)</td>
<td>(52.6 ± 12.3 yrs)</td>
<td>(49.3 ± 8.1 yrs)</td>
</tr>
<tr>
<td>Gas infusion pressure</td>
<td>15 (2 males, 3 females)</td>
<td>32 (12 males, 20 females)</td>
<td>27 (18 males, 9 females)</td>
</tr>
<tr>
<td>23 mmHg group</td>
<td>(49.6 ± 9.6 yrs)</td>
<td>(54.9 ± 11.8 yrs)</td>
<td>(51.0 ± 8.5 yrs)</td>
</tr>
</tbody>
</table>

Fig. 0

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Fig. 1 Visual evaluation of colonic dilatation

Five segments from the ascending colon to the rectum were measured by VE imaging.

The large intestine was divided into 5 segments (ascending colon: A, transverse colon: T, descending colon: D, sigmoid colon: S, and rectum: R), and the degree of colonic dilatation in the segments in prone and supine positions was given a score of 1-5 based on VE images.

Fig. 0

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Results

Comparison of colonic dilatation with and without antispasmodic treatment

The visual evaluation of colonic dilatation with and without antispasmodic treatment is shown in Table 2 on page 8.

On visual evaluation by segment in the prone position, the score was 4.30 in the cecum, 4.09 in the ascending colon, 4.28 in the transverse colon, 4.00 in the descending colon, 3.88 in the sigmoid colon, and 4.30 in the rectum in the treated group, and 4.125, 3.475, 3.55, 3.18, 3.68, and 3.93 in the untreated group, respectively. The scores of the sigmoid colon and rectum were not significantly different, but those in the other segments and the mean for all segments indicated significantly greater dilation in the antispasmodic-treated group. In the supine position, the scores were 4.51, 4.49, 4.56, 4.16, 4.02, and 3.98 in the treated group, and 4.08, 3.70, 3.65, 3.15, 3.75, and 3.48 in the untreated group, respectively. No significant differences were noted in the sigmoid colon or rectum, as in the prone position, but dilatation of the other segments and mean for all segments were significantly greater in the treated group (P<0.05).

Evaluation of colon dilatation by body size

The results of visual evaluation by BMI at a gas infusion pressure of 20 and 23 mmHg are shown in Fig. 2 on page 8. Colonic dilatation significantly worsened as the BMI increased. Elevation of the gas delivery pressure to 23 mmHg improved colonic dilatation.
Table 2. Evaluation of colonic dilatation with and without antispasmodic treatment

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>T</th>
<th>D</th>
<th>S</th>
<th>R</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prone</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antispasmodic-treated group</td>
<td>4.09±0.68</td>
<td>4.28±0.73</td>
<td>4.00±0.82</td>
<td>3.88±0.73</td>
<td>4.30±0.64</td>
<td>4.09±0.76</td>
</tr>
<tr>
<td>Antispasmodic-untreated group</td>
<td>3.48±0.96</td>
<td>3.55±1.01</td>
<td>3.18±1.01</td>
<td>3.68±0.92</td>
<td>3.93±1.14</td>
<td>3.65±1.10</td>
</tr>
<tr>
<td>P-Value</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>0.2876</td>
<td>0.186</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td><strong>Supine</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Antispasmodic-treated group</td>
<td>4.49±0.59</td>
<td>4.56±0.55</td>
<td>4.16±0.84</td>
<td>4.02±0.77</td>
<td>3.98±0.80</td>
<td>4.29±0.74</td>
</tr>
<tr>
<td>Antispasmodic-untreated group</td>
<td>3.70±1.11</td>
<td>3.65±1.14</td>
<td>3.15±1.00</td>
<td>3.75±0.81</td>
<td>3.48±1.24</td>
<td>3.63±1.13</td>
</tr>
<tr>
<td>P-Value</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>&lt;0.05</td>
<td>0.1182</td>
<td>0.092</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

A:Ascending, T:Transverse, D:Descending, S:Sigmoid, R:Rectum

Fig. 0

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Fig. 2 Comparison of colonic dilatation by BMI and gas infusion pressure

Fig. 0

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Conclusion

Favorable colonic dilatation was achieved through the use of antispasmodics on CTC, compared to that without antispasmodic treatment. Colonic dilatation worsened as the BMI of the subjects increased, but favorable dilatation could be achieved by elevating the gas infusion pressure.
References


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