Comparison of degree of colorectal distention in hysterectomy with manual air insufflation or automated CO₂ CT colonography

Poster No.: C-0795
Congress: ECR 2015
Type: Scientific Exhibit
Keywords: Cancer, Computer Applications-3D, Colonography CT, CT, Gastrointestinal tract, Computer applications, Colon
DOI: 10.1594/ecr2015/C-0795

Any information contained in this pdf file is automatically generated from digital material submitted to EPOS by third parties in the form of scientific presentations. References to any names, marks, products, or services of third parties or hypertext links to third-party sites or information are provided solely as a convenience to you and do not in any way constitute or imply ECR's endorsement, sponsorship or recommendation of the third party, information, product or service. ECR is not responsible for the content of these pages and does not make any representations regarding the content or accuracy of material in this file.

As per copyright regulations, any unauthorised use of the material or parts thereof as well as commercial reproduction or multiple distribution by any traditional or electronically based reproduction/publication method is strictly prohibited.

You agree to defend, indemnify, and hold ECR harmless from and against any and all claims, damages, costs, and expenses, including attorneys' fees, arising from or related to your use of these pages.

Please note: Links to movies, ppt slide shows and any other multimedia files are not available in the pdf version of presentations.

www.myESR.org
Aims and objectives

Colorectal cancer is considered the most common cause of death among females in Japan [1], and rectal cancer alone is the 9th most common cause of mortality in females [1]. Optical colonoscopy (OC) has been established as a preoperative examination for colorectal cancer and screening [2]. However, complete visualization of the entire colon depends on factors such as patient discomfort, the level of experience of the colonoscopist, and history of laparotomy or intrapelvic surgery.

For female patients at 40-49 years old, approximately half of cancer deaths are caused by breast cancer, uterine cancer, and ovarian cancer. OC is more difficult to perform in patients with a history of intrapelvic surgery than in those with no history of intrapelvic surgery. Benefits of computed tomography colonography (CTC) in patients with incomplete colonoscopy have been reported and automated insufflation could improve colorectal distention [3].

To the best of our knowledge, no previous reports have compared the degree of colorectal distention with different methods of insufflation in patients according to history of intrapelvic surgery.

Given this background, we designed this study to compare the degree of colorectal distention according to history of hysterectomy in patients between manual insufflation using room air and automatic insufflation using CO\textsubscript{2} at preoperative CTC.
Methods and materials

Study population
We retrospectively analyzed 89 female patients who underwent CTC between November 2011 and October 2012. The first 43 patients were examined using manual insufflation with room air (no hysterectomy, n=34; hysterectomy, n=9). The remaining 46 were examined by automated insufflation with CO₂ (no hysterectomy, n=40; hysterectomy, n=6). Using 2-dimensional transverse imaging, two radiologists independently assessed colorectal distention on a 4-point scale in the following six segments: rectum; sigmoid colon; descending colon; transverse colon; ascending colon; and cecum.

Written informed consent for OC and contrast-enhanced CTC was obtained from all patients prior to enrollment by the surgeon. The protocols for this retrospective study were approved by the review board in our institute.

Bowel preparation
Colonic cleansing as a bowel preparation was performed using 2 L of polyethylene glycol lavage solution (Niflec; Ajinomoto Pharma, Tokyo, Japan) the day before OC and 10 ml of sodium picosulfate (Laxoberon; Teijin Pharma, Tokyo, Japan) on the morning prior to OC. All patients maintained a low-fiber diet for 24 h before OC, and were not allowed to eat anything after midnight other than a small amount of water or liquid.

OC
OC was performed by an experienced endoscopist according to the standard procedure. Twenty milligrams of scopolamine butyl bromide (Buscopan; Boehringer Ingerheim, Berkshire, England) was infused before OC for all patients if the patient had no history of side effects. CTC was subsequently performed on the same day immediately after colonoscopy if no complications such as perforation or incidental bleeding were encountered during OC. In our institute, no sedation is used for OC.

Insufflation technique: manual room air technique
Manual room air insufflation was performed by four radiologists and was achieved using a standard barium enema bag (Horii Pharm, Tokyo, Japan) filled with approximately 2 L of room air. The barium enema bag was attached to a thin, soft rectal tube via a connecting tube that could be sealed with a plastic clip.

All patients were placed in the left lateral decubitus position, and an enema tube was gently inserted into the anus. The operator compressed the barium enema bag gently
over approximately 3 min. The patient was gradually shifted to a supine position after
the bag was approximately empty. A standard scout image was obtained to assess
colonic distention. Additional room air was insufflated using the enema bag if inadequate
colorectal distention was suggested on the scout view.

**Insufflation technique: automated insufflation technique**

Automated CO\textsubscript{2} insufflation was also performed by the same four radiologists. Before
CTC was performed, a thin rectal tube with retention cuff was inserted into the rectum by
experienced radiologists and inflated with 30 mL of room air.

Placement and insufflation were started with all patients in a left-lateral decubitus position.
Colonic insufflation was achieved with CO\textsubscript{2} using an automated device (PROTOCO\textsubscript{2}L;
E-Z-EM, Monroe Township, NJ). The patient was gradually moved into a supine position
after rectal pressure reached 18-20 mmHg, and the upper limit of pressure was set to
25 mmHg. A standard scout view was obtained with the patient supine, and more gas
was introduced using the automated device by elevating the pressure if findings on scout
images suggested areas of collapse.

**CTC**

Following insufflation in each procedure, contrast-enhanced CTC was performed in
both supine and prone positions, using 1.8 mg/kg of non-ionic iodine contrast material
(Iomeron; Eisai, Tokyo, Japan) administered over a period of 25 s when the body weight
was <47 kg and using 2.1 mg/kg for body weight 47 kg.

CTC was performed using a 128-detector row multi-detector row CT scanner (Somatom
Definition Flash or Somatom Definition AS; Siemens Medical Solutions, Forchheim,
Germany) with these parameters: beam collimation, 0.6 mm; reconstruction interval, 1
mm; automated exposure control, 120-220 mAs; and 120 kV.

The balloon of the rectal tube was deflated for imaging in the prone position to obtain
adequate visualization if tumor was located in the rectum on prior OC findings. No tagging
material was used in this procedure.

**Image analysis**

CT data sets were assessed by two experienced radiologists using a CTC workstation
(AZE Virtual Place; AZE, Tokyo, Japan). Multi-planar reconstruction images were
evaluated using a viewer program (AZE Virtual Place; AZE). The colon was divided into
six segments: rectum, sigmoid colon, descending colon, transverse colon, ascending
colon, and cecum (Fig. 1). The degree of colorectal distention in each segment was
assessed in the least-distended portion of the segment using a 4-point scale: 4,
optimally distended; 3, adequately, but not optimally distended; 2, partially collapsed; or 1, completely collapsed (Table 1; Fig. 2A-D). Lumens showing severe narrowing and obstruction of an entire sub-site of colon caused by the tumor itself were excluded.

**Fig. 1:** Sub site of colon and rectum

**References:** Radiology, Jichi Medical University - Shimotsuke/JP
Table 1: Scores for colorectal distention

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Partially collapsed</td>
</tr>
<tr>
<td>3</td>
<td>Adequately but not optimally distended</td>
</tr>
<tr>
<td>4</td>
<td>Optimally distended</td>
</tr>
</tbody>
</table>

**Fig. 2**: Degree of colorectal distention on 2D images of CTC. A Grade 1 distention. Complete collapse is seen in the sigmoid colon (yellow arrow). B Grade 2 distention. Partial collapse is seen in descending colon (yellow arrow). C Grade 3 distention. Adequate but not optimally distension is seen in descending colon. D Grade 4 distention. Optimally distention is seen in transverse colon.
Statistical analysis

All statistical analyses were calculated using SPSS version 21.0 software (IBM, Armonk, NY). The Mann-Whitney U test was used for comparisons of colonic distention score between supine and prone positions. Values of p<0.05 were considered statistically significant. Interobserver agreement between distention scores was assessed using weighted kappa statistics, defined as: poor, <0.2; fair, >0.2 to #0.4; moderate, >0.4 to #0.6; good, >0.6 to #0.8; and excellent, >0.8 to #1.
Fig. 1: Sub site of colon and rectum

© Radiology, Jichi Medical University - Shimotsuke/JP
Fig. 2: Degree of colorectal distention on 2D images of CTC. A Grade 1 distention. Complete collapse is seen in the sigmoid colon (yellow arrow). B Grade 2 distention. Partial collapse is seen in descending colon (yellow arrow). C Grade 3 distention. Adequate but not optimally distention is seen in descending colon. D Grade 4 distention. Optimally distention is seen in transverse colon.

© Radiology, Jichi Medical University - Shimotsuke/JP
Results

Patient characteristics, tumor location, and reasons for hysterectomy are shown in Fig. 3. No difference in colorectal distention was seen between the no-hysterectomy and hysterectomy groups using the manual method (Figs. 4, 5). In contrast, with the automated method, significant differences in distention of the transverse colon and mean distention of the entire colon were evident between the no-hysterectomy and hysterectomy groups (Figs. 6, 7).

<table>
<thead>
<tr>
<th></th>
<th>Manual</th>
<th>Automated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Hysterectomy</td>
<td>Hysterectomy</td>
</tr>
<tr>
<td></td>
<td>n=34</td>
<td>n=9</td>
</tr>
<tr>
<td>Height<a href="mean%C2%B1SD">cm</a></td>
<td>151.8±8.11</td>
<td>151.2±4.82</td>
</tr>
<tr>
<td>Weight<a href="mean%C2%B1SD">kg</a></td>
<td>52.2±8.18</td>
<td>55.2±8.79</td>
</tr>
<tr>
<td>Age<a href="mean%C2%B1SD">y</a></td>
<td>63.9±11.85</td>
<td>65.9±8.46</td>
</tr>
<tr>
<td>Tumor Location</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rectum</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Sigmoid colon</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>Descending colon</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Transverse colon</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Ascending colon</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Cecum</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Hysterectomy reason</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uterine fibroid</td>
<td>N/A</td>
<td>6</td>
</tr>
<tr>
<td>Cervical cancer</td>
<td>N/A</td>
<td>3</td>
</tr>
<tr>
<td>Uterine cancer</td>
<td>N/A</td>
<td>0</td>
</tr>
</tbody>
</table>

Fig. 3: Patient characteristics, tumor location, and reasons for hysterectomy in both groups

References: Radiology, Jichi Medical University - Shimotsuke/JP
Fig. 4: Mean score for colorectal distention by manual air insufflation (no hysterectomy vs. hysterectomy) (prone)

References: Radiology, Jichi Medical University - Shimotsuke/JP
Fig. 5: Mean score for colorectal distention by manual air insufflation (no hysterectomy vs. hysterectomy) (supine)

References: Radiology, Jichi Medical University - Shimotsuke/JP
**Fig. 6:** Mean score for colorectal distention by automated CO2 insufflation (no hysterectomy vs. hysterectomy) (prone)

**References:** Radiology, Jichi Medical University - Shimotsuke/JP
Fig. 7: Mean score for colorectal distention by automated CO2 insufflation (no hysterectomy vs. hysterectomy) (supine)

References: Radiology, Jichi Medical University - Shimotsuke/JP

Mean distention score of the entire colonic lumen was better with the automated technique than with manual insufflation for the no-hysterectomy group in both supine and prone positions (p<0.05)(Fig.8, 9).

Assessed by segment, distention was better with automated insufflation than with the manual technique in the ascending colon when the patient was prone, and in all segments when supine.

However, no significant differences were seen in mean distention of the entire colonic lumen between automated and manual techniques for patients with a history of hysterectomy (Figs. 10, 11).

Excellent interobserver agreement was seen between scores from the two radiologists (weighted kappa, 0.941) (Table 2).
Fig. 8: Mean score for colorectal distention without hysterectomy (manual vs automated) (prone)

References: Radiology, Jichi Medical University - Shimotsuke/JP
Fig. 9: Mean score for colorectal distention without hysterectomy (manual vs. automated) (supine)

References: Radiology, Jichi Medical University - Shimotsuke/JP
Fig. 10: Mean score for colorectal distention with hysterectomy (manual vs. automated) (prone)

*References:* Radiology, Jichi Medical University - Shimotsuke/JP
**Fig. 11**: Mean score for colorectal distention with hysterectomy (manual vs automated) (supine)

**References**: Radiology, Jichi Medical University - Shimotsuke/JP

<table>
<thead>
<tr>
<th></th>
<th>Manual insufflation</th>
<th>Automated insufflation</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complete agreement</td>
<td>266</td>
<td>371</td>
<td>637</td>
</tr>
<tr>
<td>Incomplete agreement</td>
<td>181</td>
<td>90</td>
<td>271</td>
</tr>
<tr>
<td>Poor agreement</td>
<td>27</td>
<td>10</td>
<td>37</td>
</tr>
<tr>
<td>No agreement</td>
<td>9</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

Table.2 Agreement between readers with each method
Fig. 2: Degree of colorectal distention on 2D images of CTC. A Grade 1 distention. Complete collapse is seen in the sigmoid colon (yellow arrow). B Grade 2 distention. Partial collapse is seen in descending colon (yellow arrow). C Grade 3 distention. Adequate but not optimally distention is seen in descending colon. D Grade 4 distention. Optimally distention is seen in transverse colon.

© Radiology, Jichi Medical University - Shimotsuke/JP
<table>
<thead>
<tr>
<th></th>
<th>Manual</th>
<th></th>
<th>Automated</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Hysterectomy</td>
<td>Hysterectomy</td>
<td>No Hysterectomy</td>
<td>Hysterectomy</td>
</tr>
<tr>
<td>n=34</td>
<td>n=9</td>
<td>n=37</td>
<td>n=9</td>
<td></td>
</tr>
<tr>
<td>Height<a href="mean%C2%B1SD">cm</a></td>
<td>151.8±8.11</td>
<td>151.2±4.82</td>
<td>151.9±8.3</td>
<td>157.6±4.27</td>
</tr>
<tr>
<td>Weight<a href="mean%C2%B1SD">kg</a></td>
<td>52.2±8.18</td>
<td>55.2±8.79</td>
<td>51.3±7.42</td>
<td>50.6±12.3</td>
</tr>
<tr>
<td>Age<a href="mean%C2%B1SD">y</a></td>
<td>63.9±11.85</td>
<td>65.9±8.46</td>
<td>62.6±13.84</td>
<td>64.0±9.07</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tumor Location</th>
<th>Manual</th>
<th>Automated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectum</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Sigmoid colon</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>Descending colon</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Transverse colon</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Ascending colon</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Cecum</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hysterectomy reason</th>
<th>Manual</th>
<th>Automated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uterine fibroid</td>
<td>N/A</td>
<td>6</td>
</tr>
<tr>
<td>Cervical cancer</td>
<td>N/A</td>
<td>3</td>
</tr>
<tr>
<td>Uterine cancer</td>
<td>N/A</td>
<td>0</td>
</tr>
</tbody>
</table>

**Fig. 3:** Patient characteristics, tumor location, and reasons for hysterectomy in both groups

© Radiology, Jichi Medical University - Shimotsuke/JP
Fig. 4: Mean score for colorectal distention by manual air insufflation (no hysterectomy vs. hysterectomy) (prone)

© Radiology, Jichi Medical University - Shimotsuke/JP
Fig. 5: Mean score for colorectal distention by manual air insufflation (no hysterectomy vs. hysterectomy) (supine)

© Radiology, Jichi Medical University - Shimotsuke/JP
Fig. 6: Mean score for colorectal distention by automated CO2 insufflation (no hysterectomy vs. hysterectomy) (prone)

© Radiology, Jichi Medical University - Shimotsuke/JP
**Fig. 7:** Mean score for colorectal distention by automated CO2 insufflation (no hysterectomy vs. hysterectomy) (supine)

© Radiology, Jichi Medical University - Shimotsuke/JP
Fig. 8: Mean score for colorectal distention without hysterectomy (manual vs automated) (prone)

© Radiology, Jichi Medical University - Shimotsuke/JP
**Fig. 9:** Mean score for colorectal distention without hysterectomy (manual vs. automated) (supine)

© Radiology, Jichi Medical University - Shimotsuke/JP
Fig. 10: Mean score for colorectal distention with hysterectomy (manual vs. automated) (prone)

© Radiology, Jichi Medical University - Shimotsuke/JP
Fig. 11: Mean score for colorectal distention with hysterectomy (manual vs automated) (supine)

© Radiology, Jichi Medical University - Shimotsuke/JP
Conclusion

Automated CO$_2$ insufflation offered improved colorectal distention in patients without hysterectomy, but no significant improvement was seen in patients with history of hysterectomy compared to manual insufflation during preoperative CTC. Our results do not support aggressive use of the automated method for CTC in patients with a history of hysterectomy.
Hidenori Kanazawa, M.D., Ph.D. Departments of Radiology, Jichi Medical University, Tochigi, Japan; r0713hk@jichi.ac.jp

Kenichi Utano, M.D., Ph.D. Department of Radiology, Aizu Medical Center, Fukushima, Japan; k-utano@nifty.com

Shigeyoshi Kijima, M.D. Departments of Radiology, Jichi Medical University, Tochigi, Japan; kijimashige@yahoo.co.jp

Takahiro Sasaki, M.D. Departments of Radiology, Jichi Medical University, Tochigi, Japan; ts01039r@yahoo.co.jp

Mizuho Suzuki, M.D. Departments of Radiology, Jichi Medical University, Tochigi, Japan; mizuho@jichi.ac.jp

Yasuyuki Miyakura, M.D., Ph.D. Departments of Surgery, Jichi Medical University, Tochigi, Japan; miyakura@jichi.ac.jp

Hisanaga Horie, M.D., Ph.D. Departments of Surgery, Jichi Medical University, Tochigi, Japan; hisahorie@jichi.ac.jp

Hideharu Sugimoto, M.D., Ph.D. Departments of Radiology, Jichi Medical University, Tochigi, Japan; sugimoto@jichi.ac.jp
References

