

**Original Article****Colonic retention of barium with and without use of laxatives after videofluoroscopic examination of swallowing**

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**ABSTRACT**

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**Objective:** Barium is generally used as the contrast medium in videofluoroscopic examination of swallowing (VF) to evaluate swallowing function. However, no consensus has been reached on the use of laxatives following VF. The objectives of the present study were to assess the status of colonic retention of barium after VF and to examine the usefulness of laxatives.

**Methods:** In study 1, 88 patients who underwent VF and abdominal radiography 3 days after VF were studied. Barium dose, site of retention, number of sites of retention, and gastrointestinal symptoms were evaluated. In study 2, 51 patients who received  $\geq 10$  g of barium at VF and laxatives were compared with 63 patients who received  $\geq 10$  g of barium without laxatives in study 1.

**Results:** In study 1, barium retention was observed in 60 patients. The barium retention and number of sites of retention were significantly greater in patients who received  $\geq 10$  g of barium ( $p < 0.001$ ). In study 2, barium at the most oral side moved more distally toward the anal side in patients who received laxatives ( $p = 0.043$ ) and the number of sites of barium retention was reduced ( $p = 0.017$ ).

**Conclusions:** Barium retention is common when  $\geq 10$  g is used in VF. Administration of laxatives promotes

barium excretion.

**Key words:** dysphagia, videofluoroscopic examination of swallowing, barium, laxative

**Introduction**

Videofluoroscopic examination of swallowing (VF) is the gold standard for the assessment of swallowing function [1–3], and barium is generally used as the contrast medium. Regarding the use of laxatives in gastrointestinal tract imaging studies, there are many reports on administration before examination [4,5], but few detailed reports on administration after examination. Massive colonic retention of barium has been reported in the elderly after examination, and retention is improved by lactulose administration [6]. Difficulties in defecation and constipation have been reported after gastrointestinal tract imaging studies, as well as subsequent occurrences of gastrointestinal tract perforation [7], peritonitis [8], and bowel occlusion [9].

Although minimizing colonic barium retention is clearly desirable, no consensus has been reached on the use of laxatives following VF. To the best of our knowledge, barium retention after VF has not been investigated. The objectives of the present study were thus to elucidate the status of colonic retention of barium after VF and to examine the usefulness of laxatives.

**Methods**

In our hospital, VF is conducted using a barium suspension at a concentration of 50% w/v; for example, the barium content of 10 mL of liquid is 5 g. This study was approved by the relevant institutional ethical committee.

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### Study 1: Status of colonic retention of barium

Patients hospitalized in our institution between September and December 2007 who were suspected of having dysphagia and underwent VF and then abdominal radiography 3 days later were included in this study. Written informed consent was obtained from the subjects or their families. Abdominal radiography was conducted in a supine position, and images up to the level of the pubic bone were acquired. Abdominal radiographs were assessed for barium retention with the greatest diameter of 10 mm or above at the most oral side and the most anal side in five colorectal sites: ascending colon, transverse colon, descending colon, sigmoid colon, and rectum (Figure 1). The dose of barium used during VF, presence or absence of barium retention, and number of sites of barium retention spanning the above-mentioned sites were assessed. In addition, abdominal symptoms including abdominal pain, vomiting, and diarrhea observed between the time of VF and radiography, as well as the status of defecation, were recorded. Diarrhea was defined as a defecation frequency of three times or more per day. The relationship between defecation status and barium dose was also analyzed.

### Study 2: Usefulness of laxative administration

Among patients who underwent VF for suspected dysphagia during hospitalization in our institution between April 2010 and July 2011, those who received 10 g or more of barium, were administered a laxative, and underwent abdominal radiography 3 days after VF



**Figure 1.** Abdominal radiograph taken 3 days after videofluoroscopic examination of swallowing.

Retention of barium continuously from the descending colon to the rectum is observed.

formed the laxative group. Written informed consent was obtained from all subjects. Patients who were administered a laxative for other reasons were excluded. Patients in this group were administered 15 drops of sodium picosulfate hydrate solution (Laxoberon<sup>TM</sup>; Teijin Pharma Ltd.) orally or via a feeding tube before bedtime on the day of VF. Abdominal radiographs were assessed for barium retention with the greatest diameter of 10 mm or above at the most oral side and the most anal side in five colorectal sites: ascending colon, transverse colon, descending colon, sigmoid colon, and rectum. The number of sites of barium retention spanning the above-mentioned sites was assessed.

Subjects in study 1 who received 10 g or more of barium were designated the non-laxative group. The site of retention and status of retention at the most anal side and the most oral side were compared. The number of sites of retention was also compared between the laxative and non-laxative groups. In addition, abdominal symptoms including abdominal pain, vomiting, and diarrhea observed between the time of VF and radiography, as well as the status of defecation, were recorded.

### Statistical analysis

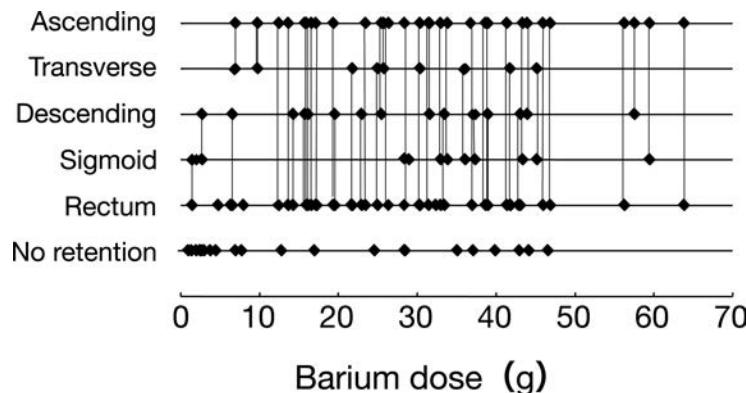
Numerical data are expressed as mean  $\pm$  standard deviation. The relation between barium dose and presence or absence of barium retention on abdominal radiograph, the relation between barium dose and status of defecation, and gender were analyzed using the Chi-square test. The numbers and site of barium retention were analyzed using the Mann-Whitney *U* test. In study 2, the mean ages and barium dose of the laxative and non-laxative groups were compared using Welch's *t*-test. Statistical analyses were performed using SPSS version 19 (IBM Japan, Tokyo, Japan). *p*-values less than 0.05 were considered to indicate statistically significant differences.

## Results

### Study 1

Eighty-eight subjects (68 males and 20 females, aged 62 $\pm$ 20 years) participated in this study. The primary diseases were cerebrovascular disease in 39 patients, head trauma in 5 patients, other cerebral diseases in 6 patients, neuromuscular disease in 12 patients, respiratory disease in 4 patients, oropharyngeal tumor in 7 patients, and other conditions in 15 patients. The dose of barium administered during VF was 24.5 $\pm$ 16.6 g. Barium retention was observed on abdominal radiographs after VF in 60 of 88 (68%) patients. Barium retention extending from the ascending colon to the rectum was observed in 19 patients, and the lowest barium dose used in these patients was 12.5 g (Figure 2).

In the barium dose  $<10$  g group, no retention was observed in 15 of 25 patients (60%). Barium retention was significantly more common in the barium dose  $\geq 10$

**Figure 2.** Barium dose and retention site in study 1.

Barium retention was observed on abdominal radiographs after videofluoroscopic examination of swallowing in 60 of 88 patients. Barium retention extending from the ascending colon to the rectum was found in 19 patients, and the smallest barium dose used in these patients was 12.5 g.

g group than in the <10 g group ( $p < 0.001$ ) (Table 1). The number of sites of retention was also significantly greater in the barium dose  $\geq 10$  g group ( $p < 0.001$ ) (Table 2). Ten patients had no defecation during the 3 days between VF and abdominal radiography. Three patients experienced abdominal pain, and one patient reported vomiting after VF, all of whom had no defecation. In the three patients with abdominal pain, the symptom was resolved after defecation. In the vomiting case, vomiting occurred on day two after VF; defecation occurred later on the same day, and there was no recurrence of vomiting. None of the patients experienced diarrhea.

## Study 2

Fifty-one patients (37 males and 14 females, aged 66±14 years) were administered a laxative. The primary diseases were cerebrovascular disease in 23 patients, head trauma in 1 patient, other cerebral diseases in 3

patients, neuromuscular disease in 1 patient, respiratory disease in 6 patients, oropharyngeal tumor in 3 patients, and other conditions in 14 patients. The dose of barium in the laxative group was  $28.8 \pm 10.2$  g. Barium retention was observed on abdominal radiographs after VF in 35 patients. Barium retention extending from the ascending colon to the rectum was found in 12 patients, and the smallest barium dose used in these patients was 15.9 g (Figure 3). Three patients reported no defecation for 3 days. Eventually, all patients had defecation, and the latest defecation was 6 days after VF.

Among the 88 patients in study 1, 63 patients (53 males and 10 females, aged 65±18 years) who received 10 g or more of barium were designated the non-laxative group. The primary diseases were cerebrovascular disease in 29 patients, head trauma in 3 patients, neuromuscular disease in 10 patients, respiratory disease in 3 patients, oropharyngeal tumor in 7 patients, and other conditions in 11 patients. The dose of barium in the non-

**Table 1.** Barium dose and status of barium retention.

Barium dose	Absence of retention	Presence of retention	Total
$\geq 10$ g	13	50	63
<10 g	15	10	25
Total	28	60	88

( $p < 0.001$ ; Chi-squared test)

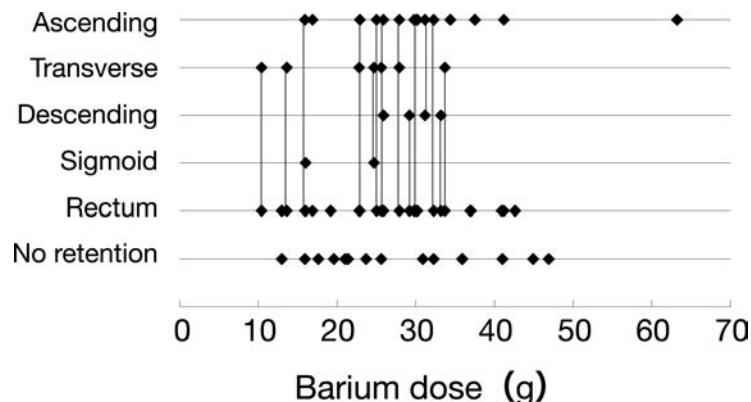
**Table 2.** Barium dose and number of sites of barium retention.

Barium dose	Number of sites of barium retention						Total
	0	1	2	3	4	5	
$\geq 10$ g	13	6	4	13	8	19	63
<10 g	15	5	4	1	0	0	25

( $p < 0.001$ ; Mann-Whitney  $U$  test)

laxative group was  $32.5 \pm 12.3$  g. No significant differences in gender, age, and the dose of barium were observed between the laxative and non-laxative groups. The two groups did not differ significantly in barium retention sites at the anal side ( $p=0.120$ ), but did differ significantly in sites at the oral side ( $p=0.043$ ); barium was also shown to move more distally to the anal side in the laxative group (Table 3). The number of sites of barium retention

was significantly lower in the laxative group ( $p=0.017$ ) (Table 4). Regarding gastrointestinal complications, three patients in the laxative group reported abdominal pain and three patients reported diarrhea. In all three patients with abdominal pain, the symptom improved after defecation. In the three patients with diarrhea, defecation occurred 4–6 times on the day after laxative administration and improved to 2–3 times 1 day later,



**Figure 3.** Barium dose administered and retention site in the laxative group in study 2.

Barium retention was observed on abdominal radiographs after videofluoroscopic examination of swallowing in 35 patients. Barium retention extending from the ascending colon to the rectum was found in 12 patients, and the smallest barium dose used in these patients was 15.9 g.

**Table 3.** Laxative use and sites of retention.

Oral side

Laxative use	No retention	Rectum	Sigmoid colon	Descending colon	Transverse colon	Ascending colon	Total
Yes	16	9	1	3	7	15	51
No	13	6	0	8	6	30	63

( $p=0.043$ ; Mann-Whitney  $U$  test)

Anal side

Laxative use	No retention	Rectum	Sigmoid colon	Descending colon	Transverse colon	Ascending colon	Total
Yes	16	29	1	2	0	3	51
No	13	36	8	4	2	0	63

( $p=0.120$ ; Mann-Whitney  $U$  test)

**Table 4.** Laxative use and extent of retention.

Laxative use	Extent of retention						Total
	0	1	2	3	4	5	
Yes	16	13	2	5	10	5	51
No	13	6	5	12	11	16	63

( $p=0.017$ ; Mann-Whitney  $U$  test)

with no diarrhea thereafter.

## Discussion

Colonic retention of barium was observed after VF in 68% of all subjects in study 1, and retention was distributed extensively from the ascending colon to the rectum in 22% of patients; all of whom received barium doses of 10 g or more. The finding that barium retention was significantly more frequent in patients administered 10 g or more indicates that, even in VF, which uses a smaller dose of barium compared with gastrointestinal imaging, retention is common when the dose exceeds a certain level. However, complications were limited to a few cases of mild symptoms including transient abdominal pain and nausea, suggesting a low risk of serious gastrointestinal complications.

Study 2 revealed that when 10 g or more of barium was used during VF, laxatives facilitated the excretion of barium toward the anal side and out of the body. According to a report on barium excretion after a gastrointestinal imaging study, barium was detected in the feces of 44% of subjects on the same day as imaging and 85% of subjects on the next day, indicating excretion within 2 days in most subjects [10]. Other studies have reported barium excretion as soon as 30 min and as late as 5 days, with the majority of excretion occurring within 20 to 40 h after gastrointestinal imaging study [11]. No serious complications such as dehydration or persistent diarrhea occurred in this study. Therefore, we verified that laxatives enhance barium excretion in a safe manner.

Although laxatives are not generally administered after VF, barium retained in the gastrointestinal tract may pose a risk of gastrointestinal perforation, peritonitis, and bowel obstruction [7–9]. Hence, the use of laxatives is recommended for patients with no contraindications who receive a barium dose of 10 g or above. When barium stagnation occurs even after laxative use, dietary content and water intake before and after the imaging study, as well as lifestyle factors including defecation patterns, may be contributing factors.

It remains unclear whether further administration of laxative should be considered in patients with barium retention even after laxative use. Abdominal radiography can be used to effectively assess barium retention in such cases. VF was conducted in patients with suspected

dysphagia, and oral administration of laxatives may cause aspiration. Therefore, the administration route of the laxative should be carefully determined on the basis of VF results. Moreover, as the patients in the laxative group and the non-laxative group in study 2 were not compared in the same period, the results should be interpreted carefully because the treatment for primary diseases may be different.

In conclusion, the present study demonstrated that barium retention is common when used at a dose of 10 g or above during VF and that laxatives are effective for promoting barium excretion.

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