Original Article

DOI: 10.5582/ddt.2018.01033

Constipation in the elderly in a Japanese long-term medical facility: An ultrasonographic investigation

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Summary **This study aims to assess the fecal retention in elderly patients using colonic ultrasonography (US) in Japanese long-term care facility and determine the correlation between nutrition management methods and the fecal retention by US. This cross-sectional, single-center study was conducted in a long-term care facility in Japan. Patients with chronic constipation fulfilled the Rome III criteria for the diagnosis of functional constipation. US was performed on constipation patients with 4-day fecal retention before starting the standard management of constipation. After patients had defecated, nurses checked the outside of feces using King's Stool Chart and Bristol Stool Chart. All of 32 patients underwent the management of suppository laxative, the daily life independence level in grade C. In all cases, the King's Stool Chart did not detect > 200 g of fecal matter; the Bristol Stool Chart revealed type 5-7 in 56.2% of patients. The total parenteral nutrition and tube feeding did not completely detect type 1-2 in 0%. While the fecal retention groups comprised 15.6%, the non-fecal retention groups comprised 84.4%. The total parenteral nutrition did not completely detect the fecal retention in 0%. In the non-fecal retention groups, the King's Stool Chart indicated < 100 g in 81.8%, and the Bristol Stool Chart indicated type 5-7 in 100%. In conclusion, fecal properties of elderly constipation patients with the long-term parenteral nutrition should be assessed in follow-up examination by US, which is possible for personalized medical care by US, to avoid the administered regular management of constipation.**

Keywords: Elderly patient, management of constipation, nutrition, ultrasonography

1. Introduction

Chronic constipation is a frequent problem of elderly people, with its symptoms reported in up to 50% of patients in long-term care (LTC) facilities (*1-3*). However, no consensus exists on the definition of constipation regarding what the elderly perceive as constipation and what physicians traditionally consider constipation (*4*). As Japan has become a super-aging society with an increasing number of older adults with cerebrovascular diseases and dementia, it could be considered that the number of older adults who could not complain of subjective symptoms or who have difficulty with communication is increasing.

Chronic constipation is attributed to various factors and can result in complications, such as impaction, even perforation and death, when left untreated or not adequately treated (*5-8*). Hence, the prevention of

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chronic constipation by the nursing staff is imperative, and when it does occur, efforts should be focused on initiating an appropriate treatment to manage the condition. Several methods can prevent and manage constipation, including changes in diet and lifestyle, as well as drug therapy options. However, Japan witnesses the highest prevalence of inappropriate medication in patients with chronic constipation (*9*) because it tends to provide excessive management of constipation to prevent fecal impaction (*10*).

Hence, the precise assessment of the fecal retention in the colon and rectum is crucial. Although typically recommended diagnostic tests for constipation include plain abdominal radiography, barium enema, colonoscopy, defecography, abdominal computed tomography, and magnetic resonance imaging (*11-13*), these procedures might provide inadequate information. Moreover, various procedures (*e.g.*, plain abdominal radiography, barium enemas, defecography, and computed tomography) are unsuitable for follow-up testing because of inherent problems related to radiation exposure. For instance, while barium enema and defecography require the use of contrast medium, colonoscopy is often poorly tolerated by patients, and magnetic resonance imaging and defecography are expensive and lack standardization.

In contrast, transabdominal sonography has been extensively applied in the clinical practice because of its low cost, safety, speed, and nonionizing radiation (*14,15*). Recently, several studies have reported using a pelvic sonography technique to diagnose constipation by measuring the rectal diameter in children; sonography images reveal a fecal mass in the rectum as a crescent-shaped acoustic shadow (*16-18*). Previously, several studies have proposed the use of colorectal ultrasonography (US) as the first-line clinical imaging and initial diagnostic technique in the colon (*19,20*). Furthermore, US can be used concomitantly to assess the fecal retention in adults along with a physical follow-up examination to assess constipation (*21,22*).

However, little information is available on the sonographic visualization of constipation among Japanese elderly patients in an LTC facility because the elderly and adults have different meal form, gastrointestinal function and rectal sensitivity (*23*). Hence, this study aims to assess the fecal retention in elderly patients by US and determine the correlation between nutrition management methods as meal form and fecal retention by the colonic US.

2. Patients and Methods

2.1. *Patients*

This cross-sectional, noninterventional, single-center study was conducted in a Japanese LTC medical facility (Sengi Hospital, Ishikawa, Japan) between March and April 2016. We enrolled patients with chronic constipation if they aged, at least, 65 years and fulfilled the Rome III criteria for the diagnosis of functional constipation. In contrast, we excluded patients with a history of abdominal surgery, Irritable bowel syndrome, organic disease, and colon gas because of the difficulty in viewing the inside of the colon because of the gas. This study protocol was approved by the Research Ethics Committee of the Graduate School of Medicine and Faculty of Medicine at the University of Tokyo (Tokyo, Japan; approval number, 10789). In addition, we obtained written informed consent from all patients or their families. Notably, all participants were free to retract their consent at any time and were encouraged to report any pain or discomfort during the colonic US examination.

2.2. *Ultrasound technique*

We first assessed patients with constipation by US imaging before starting the standard management of constipation without the 4-day defecation. Soon after, nurses administered regular management of constipation (*e.g.*, laxative, enema, and stool extraction) every day to patients until defecation. After patients defecated, nurses checked the outside of feces using the King's Stool Chart and Bristol Stool Chart. We scanned the colorectum of all patients using our systematic scanning method (*20,21*), and the resulting images were performed at the center of the ascending colon, transverse colon, descending colon, rectum, and up to the portion just beyond the left iliopsoas muscle of the sigmoid colon to easily identify all cases by transverse and longitudinal sonographic scans (Figure 1). The sonographic examinations lasted for approximately 10 min, which were performed by a certified sonographer with 30 years of experience. We used the US system (Noblus; Hitachi Aloka Medical Ltd., Tokyo, Japan) with a curved-array (5 MHz) probe.

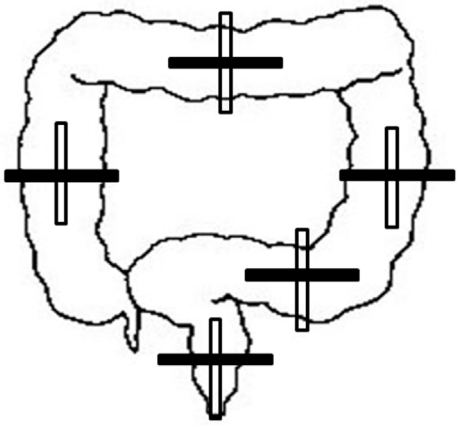

Figure 1. Sonographic scans were performed at the center of the ascending colon, transverse colon, descending colon, rectum, and up to the portion just beyond the left psoas muscle of the sigmoid colon by transverse (closed bar) and longitudinal (open bar) sonographic scans.

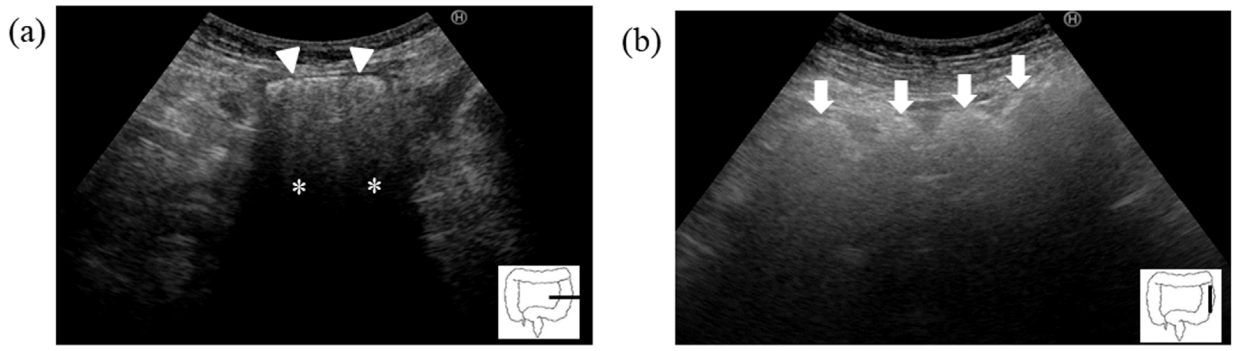

Figure 2. The presence of the fecal retention. US images of an 88-year-old female who intakes oral food. (a) A transverse scan showing a high echogenicity by the brightness of the colon wall (arrowheads) and acoustic shadow behind the descending colon (asterisks). **(b)** A longitudinal scan showing a clear crescent-shaped high echogenicity by the brightness of the colon wall with haustrations (arrows).

For US imaging, we used the focal range of 4 cm and the image depth of 6-8 cm. Furthermore, we used echo gain and dynamic range to determine the appropriate range to display.

2.3. *Data analysis*

We defined the US images before management of constipation as the fecal retention (fecal retention/non-fecal retention). The fecal retention groups suggested high echogenicity by the brightness of the colon wall with posterior echoes (acoustic shadows) by a transverse scan and visualized haustrations by a longitudinal scan (*22*); these findings were detected in any of the five sites (*i.e*., ascending, transverse, descending, sigmoid colon, and rectum; Figure 2). All US images were classified visually as the fecal retention or non-fecal retention, and two independent certified sonographers reviewed the US images to ensure the inter-rater reliability. Furthermore, an expert sonographer assessed the data derived from the US images. Of note, all images were evaluated under blinded conditions. We assessed the correlation between the visual evaluation (fecal retention/non-fecal retention) using Cohen's kappa statistic to reach a consensus between the two certified sonographers. In this study, the correlations between the fecal retention and other variables, nutrition management method [total parenteral nutrition (TPN), gastric fistula tube, tube feeding (TF), oral foods – also includes the use of TPN or gastric fistula tube in combination], amount of the King's Stool Chart and quality of the Bristol Stool Chart and bowel movement frequency were analyzed using the Fisher's exact test. We set the statistical significance level at < 0.05. Statistical analyses were conducted using IBM SPSS Statistics 21.0 for Microsoft Windows (IBM Corp., Armonk, NY).

3. Results

Table 1 summarizes patients' characteristics. Of 41 eligible patients, 8 patients were excluded because they did not defecate while nurses were providing defecation care, and 1 patient was excluded because of insufficient image quality. Thus, the final analysis comprised 32 patients (8 males and 24 females; mean age, 87.2 years; range, 74-106 years). All patients were receiving the management of constipation with laxative suppositories (bisacodyl), the daily life independence level in grade C. Table 2 presents the correlation between nutrition management methods and bowel movements. In all patients, the King's Stool Chart did not detect > 200 g of fecal matter, and the Bristol Stool Chart revealed type 5-7 (diarrhea) in 56.2% (18 of 32 patients). In addition, TPN and TF did not completely detect type 1-2 (constipation) in 0% (0 of 17 patients); TPN tended to delay the defecation. We observed a significant difference between the nutrition management method and the Bristol Stool Chart ($p = 0.01$). Table 3 summarizes US findings of the fecal retention (fecal retention/non-fecal retention). While the fecal retention groups comprised 15.6% (5 of 32) of patients, the non-fecal retention groups comprised 84.4% (27 of 32) of patients. In addition, nutrition management methods of the fecal retention groups, TPN, did not completely detect the fecal retention in 0% (0 of 15) of patients. For the non-fecal retention groups, the following three

Table 1. Participants' characteristics ($N = 32$)

Items	Mean ± SD, Min–Max or *n* (%)
Age (years)	87.7 ± 8.1, 74 – 106
Women	24 (75)
The level of independence	
Grade C (bed ridden)	32 (100)
Main disease	
Cerebrovascular disease	11 (34.4)
Fracture femoris	5 (15.6)
Lung disease	5 (15.6)
Diabetes	4 (12.5)
Cancer	2 (6.3)
Parkinson's disease	1 (3.1)
Others	4 (12.5)
Defecation care	
Suppository Laxative (Bisacodyl)	32 (100)

Table 2. The correlation between nutrition management methods and bowel movements ($N = 32$)

Items	King's Stool Chart < 100 g $n = 22$	King's Stool Chart 100 – < 200 g $n = 10$	King's Stool Chart > 200 g $n = 0$	P[1)]	Bristol Stool Chart Type 1–2 (Constipation) $n = 5$	Bristol Stool Chart Type 3–4 (Easier to pass) $n = 9$	Bristol Stool Chart Type 5–7 (Diarrhea) $n = 18$	P[1)]	Bowel movement frequency (day) 4	5	6	7	8	P[1)]
Total parenteral nutrition ($n = 15$)	13 (86.7)	2 (13.3)	0	0.111	0	3 (20.0)	12 (80.0)	0.01*	4 (26.7)	0	1 (6.7)	7 (46.7)	3 (20.0)	0.069
Gastric fistula tube ($n = 6$)	4 (66.7)	2 (33.3)	0		1 (16.7)	3 (50.0)	2 (33.3)		5 (83.3)	0	1 (16.7)	0	0	
Tube Feeding ($n = 2$)	0	2 (100.0)	0		0	1 (50.0)	1 (50.0)		2 (100.0)	0	0	0	0	
Oral foods ($n = 9$)	5 (55.6)	4 (44.4)	0		4 (44.5)	2 (22.2)	3 (33.3)		7 (77.8)	2 (22.2)	0	0	0	

Data were shown as n (%). [1)]Fisher's exact test, *$P < 0.05$.

results were obtained: the King's Stool Chart indicated under < 100 g in 81.8% (18 of 22) patients; the Bristol Stool Chart indicated type 5-7 (diarrhea) in 100% patients; and bowel movement frequency was 5-8 days in 100% of patients.

We observed a significant difference between the nutrition management method and the Bristol Stool Chart ($p = 0.01$). A significant difference was also observed in nutrition management methods between the fecal retention and non-fecal retention groups ($p = 0.041$). In addition, we observed a significant difference in the Bristol Stool Chart between the fecal retention and non-fecal retention groups ($p = 0.002$). Based on the Kendall W test, the results obtained by two independent sonographers (A and B) at 0.83 and 0.84, respectively, exhibited a significant correlation with each other.

4. Discussion

This study investigated elderly patients with constipation by colonic US imaging in LTC facilities. Consequently, US images categorized constipation as fecal retention and non-fecal retention. In the fecal retention groups, the fecal retention was < 15.6% (5 of 32 patients) before management of constipation. Several factors are accountable for the fecal retention in the colon in elderly patients with constipation.

Perhaps, the low detection rate in this study could be attributed to the nutrition management methods. Reportedly, parenteral nutrition of this condition is widely used in hospitalized patients, especially elderly, who are unable to eat to aid in patients' ability to recover from illness (*24*). The most common adverse effect of such treatment is diarrhea, which is reported in 68% of intensive care unit patients (*25*) and 96% of patients with dysphagia (*26*). In this study, we compared nutrition management methods with US finding in elderly patients with constipation. All TPN were not completely detected in the fecal retention groups of US finding; even the oral foods groups did not detect fecal retention in 66.4% of patients by US. Perhaps, the dietary intake of elderly patients was not sufficient for the fecal retention for 4 days.

Another probable reason for the low detection rate in this study could be that nurses only checked the outside of feces using the King's Stool Chart and Bristol Stool Chart. While the King's Stool Chart tends to detect < 200 g of defecated feces, the Bristol Stool Chart tends to report diarrhea in the non-fecal retention groups. This study reports a markedly high prevalence and use of medications to manage elderly constipation in LTC settings (*27*). The most frequently used solution to prevent or treat constipation was laxative medications. Despite considering laxatives as the solution, it was impossible to manage the balance between constipation and diarrhea because diarrhea is the common side

Table 3. The correlation between clinical features and fecal retention by evaluation on ultrasonography

Items	Fecal retention (n = 5), n (%)	Non-fecal retention (n = 27), n (%)	P[1)]
Nutrition management methods			0.041*
Total parenteral nutrition	0 (0)	15 (100)	
Gastric fistula tube	1 (16.7)	5 (83.3)	
Tube Feeding	1 (50.0)	1 (50.0)	
Oral foods	3(33.3)	6 (66.4)	
King's Stool Chart			1.000
< 100 g	4 (18.2)	18 (81.8)	
100-200 g	1 (10.0)	9 (90.0)	
> 200 g	0 (0)	0 (0)	
Bristol Stool Chart			0.002*
Type 1-2 (Constipation)	3 (60.0)	2 (40.0)	
Type 3-4 (Easier to pass)	2 (22.2)	7 (77.8)	
Type 5-7 (Diarrhea)	0 (0)	18 (100.0)	
Bowel movement frequency (day)			0.517
4	5 (27.8)	13 (72.2)	
5	0 (0)	2 (100)	
6	0 (0)	2 (100)	
7	0 (0)	7 (100)	
8	0 (0)	3 (100)	

[1)]Fisher's exact test. *P < 0.05.

effects of laxative use, and some patients do respond to laxative treatment with diarrhea (*28,29*). In addition, the repeated use of laxative medications might weaken the efficacy of laxatives and result in anorectal burning. In particular, the first-line treatments for constipation in bedridden patients should be not laxative overdoses and need a long-term administration to keep the normal bowel movement (*30*). Perhaps, intractable diarrhea might be the major indication for TPN.

In this study, nurses administered regular management of constipation (laxative suppository) in patients without the 4-day defecation in an LTC facility because the healthcare provider attempt to avoid severe chronic constipation in complications like fecal impaction or idiopathic perforation of the colon. Thus, it is a tendency for the uniformity and excessive management of constipation. This study suggests that a follow-up examination by the colonic US can locate the fecal retention and assess it in the colon, supposedly proposing the most optimum management of constipation, which facilitates in selecting laxatives or enemas to treat constipation.

This study has some apparent limitations. First, constipation could not be assessed adequately on US images alone. No single test can adequately assess the pathophysiology of constipation because of the physiological phenomenon of the fecal retention in the colon. Hence, these patients must undergo a comprehensive diagnostic evaluation based on their clinical condition and other examination findings. Second, an additional consideration is the dependence of the efficacy of US on operators' skill and technique.

In conclusion, this study demonstrates that US could evaluate the risk factors associated with elderly constipation in LTC facilities. The fecal properties of elderly patients with constipation and parenteral nutrition should be assessed and followed up by colonic US, personalized medical care by US (if possible), avoiding the administered regular management of constipation.

Acknowledgements

We thank all participants and healthcare professionals at Sengi hospitals in the Ishikawa Prefecture.

Conflict of Interest

This study was a joint research program with FUJIFILM Corporation and was conducted under the sponsorship of this organization.

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(Received June 12, 2018; Revised August 14, 2018; Accepted August 18, 2018)