

# World Journal of *Gastroenterology*

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2014-2017

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## Retrospective Study

**Study to determine guidelines for pediatric colonoscopy**

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**Author contributions:** Yoshioka S and Takedatsu H contributed equally to this work; Yoshioka S, Takedatsu H, Mitsuyama K and Torimura T designed the research; Yoshioka S, Takedatsu H, Fukunaga S, Kuwaki K, Yamasaki H, Yamauchi R, Mori A, Kawano H, Tsuruta O, Yanagi T, Mizuochi T and Ushijima K performed the research; Yoshioka S and Takedatsu H analyzed the data; Yoshioka S and Takedatsu H wrote the paper.

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**Informed consent statement:** Patients were not required to give informed consent to the study because the analysis used anonymous clinical data that were obtained after each patient agreed to treatment by written consent. For full disclosure, the details of the study are published on the home page of Kurume University.

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**Abstract****AIM**

To investigate characteristics, diagnosis, bowel-cleansing preparation, sedation, and colonoscope length and diameter in Japanese pediatric patients receiving total colonoscopy.

**METHODS**

The present study evaluated consecutive patients aged  $\leq 15$  years who had undergone their first colonoscopy in Kurume University between January 2007 and February 2015. Data were retrospectively analyzed. We identified 110 pediatric patients who had undergone colonoscopy that had reached the cecum, allowing the observation of the total colon.

## RESULTS

Hematochezia, abdominal pain, and diarrhea were the most common symptoms. For bowel-cleansing preparation, pediatric patients aged  $\leq 12$  years were treated with magnesium citrate, and patients aged 13-15 years were treated with polyethylene glycol 4000. For sedation, thiamylal with pentazocine, which has an analgesic effect, was used in patients aged  $\leq 6$  years, and midazolam with pentazocine was used in patients aged  $\geq 7$  years. Regarding the choice of endoscope, short and thin endoscopes were selected for younger patients, particularly patients aged  $\leq 3$  years. Positive diagnoses were made in 78 patients (70.9%). Inflammatory bowel disease ( $n = 49$ , 44.5%), including ulcerative colitis ( $n = 37$ , 33.6%) and Crohn's disease ( $n = 12$ , 10.9%), was the most common diagnosis.

## CONCLUSION

Colonoscopy offers a high diagnostic capability for pediatric patients with gastrointestinal symptoms. The selection of appropriate management the performance of colonoscopy is important in pediatric patients.

**Key words:** Pediatric endoscopy; Sedation; Bowel cleansing preparation; Inflammatory bowel disease; Complication

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**Core tip:** A guideline for pediatric colonoscopy management have yet to be established in Japan. We investigated clinical characteristics, diagnostic utility, bowel cleansing preparation, sedation, and colonoscope length and diameter under 15 years of age who had undergone their first colonoscopy in our institution. Our results revealed that the symptoms associated with the indication of pediatric colonoscopy were hematochezia, abdominal pain, and diarrhea. Positive diagnoses were obtained in a majority of pediatric patients. More than 40% of patients were diagnosed with inflammatory bowel disease. Thus, our findings demonstrate the utility of colonoscopy as a diagnostic tool in pediatric patients with gastrointestinal symptoms.

Yoshioka S, Takedatsu H, Fukunaga S, Kuwaki K, Yamasaki H, Yamauchi R, Mori A, Kawano H, Yanagi T, Mizuochi T, Ushijima K, Mitsuyama K, Tsuruta O, Torimura T. Study to determine guidelines for pediatric colonoscopy. *World J Gastroenterol* 2017; 23(31): 5773-5779 Available from: URL: <http://www.wjgnet.com/1007-9327/full/v23/i31/5773.htm> DOI: <http://dx.doi.org/10.3748/wjg.v23.i31.5773>

## INTRODUCTION

Colonoscopy is routinely performed in infants and children for the evaluation and treatment of diarrhea, weight loss, abdominal pain, unexplained iron deficiency

anemia, abdominal pain, or rectal bleeding<sup>[1]</sup>. Colonoscopy has utility as a diagnostic and therapeutic tool for pediatric patients<sup>[2]</sup>. Recently, the American Society for Gastrointestinal Endoscopy (ASGE) and the North American Society for Pediatric Gastroenterology, Hepatology and Nutrition published modifications of their guidelines for pediatric patients, in which clear indications for colonoscopy in children were recommended<sup>[2]</sup>. As the diagnosis of bowel diseases, including inflammatory bowel disease (IBD) and polyposis syndrome, is important in children as well as adults, it has become increasingly necessary to perform total colonoscopy in pediatric patients<sup>[3,4]</sup>.

There are limited pediatric data regarding the complication rates of pediatric colonoscopy. Thakkar *et al*<sup>[5]</sup> reported a complication rate of 1.1%, which was higher than that of adult colonoscopy (0.4%), in a multi-center retrospective study<sup>[6]</sup>. Furthermore, pediatric colonoscopy is associated with a greater risk of serious complications compared with that in adults, due to the high level of technical difficulty, low compliance with bowel cleansing, and uncooperativeness during the procedure. The success of total colonoscopy relies on suitable bowel-cleansing preparation, appropriate sedation for painless and safe colonoscopy, and the choice of an appropriate endoscope.

Bowel preparation regimens for pediatric colonoscopy have yet to be standardized and vary among medical centers. Propofol is commonly used for sedation during pediatric endoscopy<sup>[7]</sup>. The use of midazolam, fentanyl, meperidine, ketamine, and ketofol in pediatric colonoscopy have also been reported<sup>[8]</sup>. The dosing of sedative drugs is based on patient weight and is titrated by response, allowing adequate time between doses to assess the effects and the need for additional medication. Furthermore, there are few published data to support the choice of colonoscope in Japanese pediatric patients. Recommendations based on clinical experience suggest the use of a standard or pediatric colonoscope in patients weighing 12-15 kg, the use of infant or standard adult gastroscopes in patients weighing 5-12 kg, and the use of ultra-thin gastroscopes in patients weighing  $< 5$  kg<sup>[9]</sup>.

Here we conducted a retrospective study of medical records to assess the appropriate management for performing colonoscopy in pediatric patients at our hospital. The aims of the present study were to assess the following: (1) patient clinical characteristics; (2) bowel-cleansing preparation; (3) sedation; (4) the choice of endoscope; and (5) the diagnostic utility of colonoscopy in pediatric patients.

## MATERIALS AND METHODS

### Study protocol and data collection

Colonoscopies were performed in children after clinical evaluation by pediatric gastroenterologists at Kurume University School of Medicine. In the present study, we retrospectively reviewed the medical records of

**Table 1** Characteristics of pediatric patients

Total number of patients		<i>n</i> = 110
Age (yr)	0	3
	1-3	14
	4-6	11
	7-9	19
	10-12	32
	13-15	31
Gender	Male	61
	Female	49
Reason for endoscopy	Hematochezia	62
	Abdominal pain	20
	Diarrhea	19
	Anemia	2
	Anal fistula	2
	Genital ulcer	2
	Other	2
Diagnosis	Ulcerative colitis	37
	Crohn's disease	12
	No specific colitis	13
	Juvenile polyp	7
	Normal	32
	Other	9

pediatric patients aged  $\leq 15$  years who had undergone their first diagnostic total colonoscopy between January 1, 2007 and February 28, 2015. Endoscopic procedures were performed by two advanced experienced endoscopists. The present study protocol was approved by the Human Ethics Committee of Kurume University School of Medicine.

### Bowel-cleansing preparation

Magnesium citrate (Magcorol), polyethylene glycol (PEG) 4000, and glycerin enema (GE), which are licensed for bowel-cleansing preparation in Japan, were used. Bowel-cleansing preparation protocols for colonoscopy in pediatric patients were selected depending on patient age, body weight, and clinical state by pediatric gastroenterologists.

### Sedation

Sedation methods were selected at the discretion of pediatric gastroenterologists. Thiamylal, the combination of thiamylal and pentazocine, midazolam, and the combination of midazolam and pentazocine were used for sedation in pediatric patients. Continuous pulse oximetry and heart rate monitoring were performed throughout sedation to monitor patient vital signs. The initial intravenous dose of thiamylal was 20-30 mg/kg, with an additional 10 mg depending on patient condition. The initial intravenous dose of midazolam was 0.025-0.1 mg/kg, with an additional 1 mg depending on patient condition. Pentazocine was intravenously administered at a dose of 0.5 mg/kg in combination with thiamylal or midazolam.

### Endoscopes

Endoscopes were selected based on patient age and body size by endoscopists. Carbon dioxide was used as much as possible during colonoscopy. Mucosal biopsies

were not routinely performed and were performed based on the presence of macroscopic abnormalities and endoscopist experience.

## RESULTS

### Characteristics of pediatric patients who underwent colonoscopy

Children aged  $\leq 15$  years who were referred for gastrointestinal symptoms with an indication for diagnostic colonoscopy were recruited between January 1, 2007 and February 28, 2015 (Table 1). A total of 110 individual pediatric patients, including patients aged  $< 1$  year ( $n = 3$ , 2.7%), 1-3 years ( $n = 14$ , 12.7%), 4-6 years ( $n = 11$ , 10.0%), 7-9 years ( $n = 19$ , 17.3%), 10-12 years ( $n = 32$ , 29.1%), and 13-15 years ( $n = 31$ , 28.2%), were prepared for total colonoscopy by pediatric gastroenterologists. All 110 patients (100%) in whom colonoscopy reached the cecum, allowing the evaluation of the total colon from the cecum to the rectum, were included in the present study to evaluate factors related to total colonoscopy success. No complications were reported in any of the included cases. The terminal ileum was observed for diagnostic purposes in the majority of patients (105/110, 95.5%).

In the present study, 61 boys (55.5%) and 49 girls (44.5%) were included, with a male-to-female ratio of 1.2:1. Hematochezia, abdominal pain, and diarrhea were the most common indications for pediatric endoscopy, accounting for 62 (56.4%), 20 (18.1%), and 19 (17.3%) patients, respectively. Other presentations were anemia ( $n = 2$ , 1.8%), anal fistula ( $n = 2$ , 1.8%), genital ulcer ( $n = 2$ , 1.8%), and others ( $n = 2$ , 1.8%). Final diagnoses included IBD, comprising ulcerative colitis (UC;  $n = 37$ , 33.6%) and Crohn's disease (CD;  $n = 12$ , 10.9%), non-specific colitis (NSC;  $n = 13$ , 11.8%), juvenile polyp (JP;  $n = 7$ , 6.4%), and normal ( $n = 32$ , 29.1%). Of the 49 patients with IBD, UC ( $n = 37$ , 75.5%) was more common than CD ( $n = 12$ , 24.5%). Other diagnoses ( $n = 9$ , 8.2%) included Peutz-Jeghers syndrome ( $n = 3$ , 2.7%), familial adenomatous polyposis ( $n = 2$ , 1.8%), Behçet's disease ( $n = 1$ , 0.9%), diverticulitis ( $n = 1$ , 0.9%), internal hemorrhoids ( $n = 1$ , 0.9%), and venous angioma syndrome ( $n = 1$ , 0.9%).

### Use of bowel-cleansing preparation and sedation

Table 2 shows the preparation methods used for bowel cleansing. Bowel-cleansing preparation protocols for colonoscopy in pediatric patients were selected by pediatric gastroenterologists. In all cases, bowel-cleansing preparation was effective and satisfactory. A total of 74 patients (67%) used Magcorol as a preparation. The remaining 27 patients (24.5%) used PEG-4000. GE alone was used in five patients (4.6%), all of whom had chronic diarrhea. The method of bowel preparation used was not recorded in four patients (3.6%). The majority of patients aged  $\leq 12$  years (63/79, 84.0%) were treated with Magcorol, and the

**Table 2 Bowel cleansing preparation *n* (%)**

Age	<i>n</i>	Magcorol	PEG	GE	Unknown
0	3	2 (66.7)	0 (0.0)	1 (33.3)	0 (0.0)
1-3	14	10 (71.4)	1 (7.1)	1 (7.1)	2 (14.3)
4-6	11	9 (81.8)	0 (0.0)	1 (9.1)	1 (9.1)
7-9	19	15 (78.9)	2 (10.5)	1 (5.3)	1 (5.3)
10-12	32	27 (84.4)	4 (12.5)	1 (3.1)	0 (0.0)
13-15	31	11 (35.5)	20 (64.5)	0 (0.0)	0 (0.0)
Total	110	74 (67.3)	27 (24.5)	5 (4.6)	4 (3.6)

Magcorol: Magnesium citrate; PEG: Polyethylene glycol; GE: Glycerin enema.

majority of patients aged 13-15 years were treated with PEG-4000.

Sedation was used in 85 patients (77.3%) for colonoscopy (Table 3). Thiamylal, the combination of thiamylal and pentazocine, midazolam, and the combination of midazolam and pentazocine were predominantly used for sedation at our hospital. More than half of the patients aged  $\leq 6$  years (15/28, 53.6%) were sedated with thiamylal, and the majority of patients aged  $\geq 7$  years (52/82, 63.4%) were sedated with midazolam. Pentazocine in combination with thiamylal or midazolam was used for analgesia in 78 patients (70.9%). Sedation and analgesia were not required in 20 patients aged  $\geq 10$  years (20/110, 18.2%). All patients were monitored by pediatric gastroenterologists and recovered after the procedure. No complications such as hypoxia or allergy occurred during the sedation.

#### Characteristics of colonoscopes used in pediatric patients

Two types of colonoscope, 1030 mm and 1330 mm, are used at our university. Endoscopes with a length of 1030 mm, typically used for upper endoscopy, were used for colonoscopy in 16 patients (14.5%; Table 4). In detail, all patients aged  $< 1$  year (3/3, 100%) and the majority of patients aged 1-3 years (11/14, 78.6%) underwent colonoscopy using a 1030-mm endoscope due to their small body size. The majority of patients aged 4-6 years (9/11, 81.8%) and all patients aged  $\geq 7$  years (82/82, 100%) underwent colonoscopy with a 1330-mm endoscope. Furthermore, endoscopes with six different shaft diameters were used in the present study (Table 5). We selected endoscopes with diameters of 11.7 mm ( $n = 26$ , 23.6%), 11.3 mm ( $n = 59$ , 53.6%), 9.2 mm ( $n = 9$ , 8.2%), 5.4 mm ( $n = 8$ , 7.3%), 10.5 mm ( $n = 5$ , 4.5%), and 9.8 mm ( $n = 3$ , 2.7%), according to patient age and clinical status. Endoscopes with a diameter of 5.4 mm, considered ultra-thin and typically used for nasal endoscopy, were used in all patients aged  $< 1$  year (3/3, 100%) and in one-third of patients aged 1-3 years (5/14, 35.7%). The majority of patients aged  $\geq 7$  years (total 82 patients) underwent colonoscopy using endoscopes with a diameter of 11.3 mm (53/82, 64.6%) or 11.7 mm (25/82, 30.5%). No serious complications such as

bleeding or perforation occurred during colonoscopy in any patient. Thus, endoscopes matched according to patient body size and age were appropriately selected by endoscopists in the present study.

#### Association between presenting symptoms and final diagnoses

A total of 78 patients (78/110, 70.9%) had a positive diagnosis following colonoscopy, whereas no abnormalities were observed in 32 patients (29.1%). IBD, comprising UC (37/110, 33.6%) and CD (12/110, 10.9%), was the most common diagnosis. Additional findings included JP (7/110, 9.0%) and others (18/110, 23.1%). Hematochezia, which was the most common indication for pediatric colonoscopy (63/110, 57.3%), demonstrated a high positive diagnosis rate (54/63, 85.7%), particularly for UC (34/63, 54.0%). Abdominal pain and diarrhea were predominantly present in normal cases (50.0% and 52.6%, respectively) and CD (30.0% and 21.1%, respectively). These results demonstrate that hematochezia, abdominal pain, and diarrhea as important indications for total colonoscopy in pediatric patients. Further studies of pediatric colonoscopy are required to validate these findings regarding the associated between symptoms and final diagnoses (Table 6).

## DISCUSSION

PEG is the most commonly used bowel-cleansing agent for bowel preparation regimens in children. Previous reports have demonstrated that PEG-3350 with simethicon has greater efficacy than other methods of pediatric bowel cleansing<sup>[10]</sup>. However, a proportion of pediatric patients are unlikely to ingest sufficient volumes due to its noxious taste<sup>[11]</sup>. The majority of prospective and comparative studies of bowel preparation for pediatric colonoscopy have been performed at single centers<sup>[11-13]</sup>. Recently, a randomized, blinded trial was conducted for bowel-cleansing preparation in pediatric patients who were randomly assigned to receive PEG 4000 with simethicon (PEG-S group), PEG-4000 with citrates and simethicone plus bisacodyl (PEG-CS + Bisacodyl group), PEG-3350 with ascorbic acid (PEG-Asc group), or sodium picosulfate plus magnesium oxide and citric acid (NaPico + MgCit group)<sup>[14]</sup>. In this study, PEG-CS + Bisacodyl, PEG-Asc, and NaPico + MgCit were all found to be non-inferior to PEG-S with respect to bowel-cleansing efficacy. NaPico + MgCit was reported as the most appropriate regimen for bowel preparation in children due to higher tolerability and a greater acceptability profile. PEG-4000 is the most commonly used agent in bowel-cleansing preparations for adult colonoscopy in Japan<sup>[15]</sup>. Only two kinds of bowel-cleansing preparation, PEG-4000 and Magcorol, are routinely used for children in Japan. The results of the present study demonstrated that the use of Magcorol with magnesium citrate has efficacy in bowel cleansing

**Table 3 Sedation *n* (%)**

Age	<i>n</i>	Thiamylal	Thiamylal + Pentazocine	Midazolam	Midazolam + Pentazocine	None	Unknown
0	3	0 (0.0)	1 (33.3)	0 (0.0)	2 (66.7)	0 (0.0)	0 (0.0)
1-3	14	1 (7.1)	7 (50.0)	1 (7.1)	3 (21.4)	0 (0.0)	2 (14.3)
4-6	11	1 (9.1)	5 (45.5)	0 (0.0)	4 (36.4)	0 (0.0)	1 (9.1)
7-9	19	0 (0.0)	2 (10.5)	0 (0.0)	15 (78.9)	0 (0.0)	2 (10.5)
10-12	32	1 (3.1)	4 (12.5)	2 (6.3)	21 (65.6)	4 (12.5)	0 (0.0)
13-15	31	0 (0.0)	1 (3.2)	1 (3.2)	13 (41.9)	16 (38.7)	0 (0.0)
Total	110	3 (2.7)	20 (18.2)	4 (3.6)	58 (52.7)	20 (18.2)	5 (4.5)

**Table 4 Length of endoscope *n* (%)**

Age	<i>n</i>	1030 mm	1330 mm
0	3	3 (100.0)	0 (0.0)
1-3	14	11 (78.6)	3 (21.4)
4-6	11	2 (18.2)	9 (81.8)
7-9	19	0 (0.0)	19 (100.0)
10-12	32	0 (0.0)	32 (100.0)
13-15	31	0 (0.0)	31 (100.0)
Total	110	16 (14.5)	94 (85.5)

and has greater tolerability in children aged  $\leq 12$  years (63/79, 79.7%).

The purpose of sedation is to reduce patient anxiety and discomfort and the risk of injury during the procedure. The level of sedation targeted and the sedative agents chosen depend on the characteristics of the endoscopic procedure, including the type and length of procedure, degree of invasiveness, and endoscopist experience. Physiological differences between pediatric and adult patients alter the risks of potentially serious complications during sedation. Propofol, a phenol derivative with sedative, hypnotic, and anesthetic properties without analgesic effects, is routinely used for pediatric sedation<sup>[7]</sup>. The major disadvantage of propofol is its narrow therapeutic range and the risk of inadvertent anesthesia. Therefore, although, propofol is routinely administered by anesthesiologists, its use by non-anesthesiologists remains controversial<sup>[16,17]</sup>. In fact, propofol is rarely used in Japan because pediatric colonoscopy is performed without the presence of an anesthesiologist. Thiamylal, which has sedative, anticonvulsant, and hypnotic effects, is a barbiturate derivative invented in the 1950s. Thiamylal has been used for the induction of surgical anesthesia<sup>[18]</sup> and as an anticonvulsant to counteract the side-effects of other anesthetic agents<sup>[19]</sup>. We used thiamylal in more than half of the pediatric patients aged  $\leq 6$  years (15/28, 53.6%) because it has a strong sedative effect while also being short-acting. Midazolam is a small, water-soluble benzodiazepine with anxiolytic, amnestic, sedative, muscle-relaxant, and anticonvulsant properties, which is widely used for sedation but generally considered to be insufficient as a monotherapy. Pentazocine is a synthetically prepared prototypical mixed agonist-antagonist narcotic drug of the benzomorphan class of opioids used to treat moderate-to-moderately severe pain. Pentazocine was

used in our series as an analgesic agent, in combination with thiamylal (20/23, 87.0%) and midazolam (58/62, 93.5%). Although colonoscopy in adults has been performed without sedation at our hospital, no patient aged  $\leq 9$  years and only 20 patients aged 10-15 years (20/63, 31.7%) received colonoscopy without sedation. The use of adequate sedation in pediatric patients is necessary to safely perform total colonoscopy.

The technical aspects of colonoscopy are similar between adults and children. However, adequate knowledge and good endoscopic technique are required due to a high rate of complications, the small body size of pediatric patients, and the excessive stretching of splenic and hepatic flexures associated with the use of thin endoscopes. Obvious differences between pediatric and adult colons are their length and diameter. The length of the colon is approximately 600 mm in patients aged 1 year, which increases to 1000 mm at 3 years, 1200 mm at 5 years, and finally reaches a length of 1500 mm in adults<sup>[20,21]</sup>. Variable insertion tube lengths (1030-1330 mm) and shaft diameters (5.6-11.8 mm) were used for pediatric colonoscopy. There are no published data to support colonoscope choice in children. Recommendations based on body weight have been published by the ASGE<sup>[9]</sup>. In general, the use of adult colonoscopes is acceptable in teenage patients. Smaller, more flexible colonoscopes are suitable for the majority of average-sized preschool- and elementary school-age children<sup>[22]</sup>. However, pediatric colonoscopes may be too large for children aged  $< 4$  years<sup>[23]</sup>. In the present study, we recommended the use of a standard colonoscope in patients aged  $\geq 4$  years, a standard adult gastroscope in patients aged 1-3 years, and an ultra-thin gastroscope in patients aged  $< 1$  year. As data regarding body weight was not available for all patients, body weight-based analyses should be performed in future studies.

Common inductions for pediatric colonoscopy include chronic diarrhea, hematochezia, unexplained anemia, polyposis syndrome, and failure to thrive/weight loss<sup>[2]</sup>. In the present study, hematochezia, abdominal pain, and diarrhea were the most common presentations for pediatric colonoscopy referrals, corroborating the findings of a previous study<sup>[24]</sup>. Hematochezia was the most common symptom in patients with UC, whereas abdominal pain and diarrhea were the most common symptoms in CD patients. Compared with adults, pediatric patients are reported

**Table 5 Shaft diameter of endoscope *n* (%)**

Age	<i>n</i>	5.4 mm	9.2 mm	9.8 mm	10.5 mm	11.3 mm	11.7 mm
0	3	3 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)
1-3	14	5 (35.7)	4 (28.6)	2 (14.3)	1 (7.1)	1 (7.1)	0 (0.0)
4-6	11	0 (0.0)	3 (27.3)	1 (9.1)	1 (9.1)	5 (45.5)	1 (9.1)
7-9	19	0 (0.0)	1 (5.3)	0 (0.0)	1 (5.3)	14 (73.7)	3 (15.8)
10-12	32	0 (0.0)	0 (0.0)	0 (0.0)	2 (6.3)	22 (68.8)	9 (28.1)
13-15	31	0 (0.0)	1 (3.2)	0 (0.0)	0 (0.0)	17 (54.8)	13 (41.9)
Total	110	8 (7.3)	9 (8.2)	3 (2.7)	5 (4.5)	59 (53.6)	26 (23.6)

**Table 6 Symptoms and final diagnosis *n* (%)**

	<i>n</i>	UC	CD	NSC	JP	Normal	Other
Hematochezia	63	34 (54.0)	1 (1.5)	6 (9.5)	7 (11.1)	9 (14.3)	6 (9.5)
Abdominal pain	20	1 (0.5)	6 (30.0)	2 (10.0)	0 (0.0)	10 (50.0)	1 (0.5)
Diarrhea	19	1 (5.3)	4 (21.1)	3 (15.7)	0 (0.0)	10 (52.6)	1 (5.3)
Anemia	2	1 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (50.0)	0 (0.0)
Anal fistula	2	0 (0.0)	1 (50.0)	1 (50.0)	0 (0.0)	0 (0.0)	0 (0.0)
Genital ulcer	2	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)
Other	2	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	2 (100.0)	0 (0.0)
Total	110	37 (33.6)	12 (10.9)	12 (10.9)	7 (6.4)	32 (29.1)	10 (9.1)

UC: Ulcerative colitis; CD: Crohn's disease; NSC: Non-specific colitis; JP: Juvenile polyposis.

to have a higher frequency of positive findings resulting from colonoscopy<sup>[24-26]</sup>. In the present study, 71.9% (78/110) of patients had a positive diagnosis, including UC, CD, non-specific colitis, and JP. IBD consists of two major distinct disorders, CD and UC, and is characterized by chronic inflammation of the intestine as a result of undefined pathogenic mechanisms. In the present study, IBD (49/110, 44.5%) was the most common positive finding in pediatric colonoscopy patients. Community-based epidemiological studies have demonstrated a markedly higher incidence of IBD in Japanese and other Asian adults<sup>[27,28]</sup>. In pediatric patients, several studies have reported an increasing incidence of pediatric IBD<sup>[3,4]</sup>. In the present study, there were more UC patients than CD patients. IBD patients consistently presented with abdominal pain, hematochezia, or non-infected diarrhea. Therefore, the results of the present study indicate that colonoscopy has utility as a diagnostic tool for pediatric patients presenting with hematochezia, abdominal pain, or diarrhea. In addition, our finding suggests that the observation of terminal ileum is needed to diagnose IBD, especially CD.

In conclusion, the selection of appropriate management approaches before and during the performance of colonoscopy is important in pediatric patients. Colonoscopy has utility as a diagnostic tool for pediatric patients with gastrointestinal symptoms and may represent an important component of treatment strategies for early and appropriate treatment of pediatric patients.

## COMMENTS

### Background

Colonoscopy has utility as a diagnostic and therapeutic tool in both adults and

pediatric patients. However, specific guidelines for the management of pediatric colonoscopy are not well established. They investigated clinical characteristics, diagnostic utility, bowel-cleansing preparation, sedation, and endoscope length and diameter in pediatric patients receiving total colonoscopy.

### Research frontiers

Although colonoscopy is commonly used as a diagnostic and therapeutic tool for adults and children. However, a guideline for pediatric colonoscopy management have yet to be established in Japan.

### Innovations and breakthroughs

In this study, the authors investigated 110 patients under 15 years of age who had undergone their first colonoscopy in our institution between January 2007 and February 2015. These results showed the appropriate management of pediatric colonoscopy in bowel cleansing preparation, sedation, and the selection of colonoscopy. The authors also revealed that the symptoms associated with the indication of pediatric colonoscopy were hematochezia, abdominal pain, and diarrhea. Positive diagnoses were obtained in a majority of pediatric patients. More than 40% of patients were diagnosed with inflammatory bowel disease. Thus, our findings demonstrate the utility of colonoscopy as a diagnostic tool in pediatric patients with gastrointestinal symptoms.

### Applications

This study suggests that colonoscopy has utility as a diagnostic tool for pediatric patients with gastrointestinal symptoms and may represent an important component of treatment strategies for early and appropriate treatment of pediatric patients.

### Peer-review

The author mentioned the management and diagnosis of pediatric colonoscopy in many cases. This is a very important report.

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