ORIGINAL ARTICLE

소아내시경의 임상적 의의와 실태

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Current Status and Clinical Impact of Pediatric Endoscopy in Korea

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Background/Aims: In pediatrics, endoscopic examination has become a common procedure for evaluation of gastrointestinal presentations. However, there are limited data on pediatric endoscopy in Korea. The aim of this study was to analyze the current status and clinical impacts of endoscopic examination in children and adolescents.
Methods: We retrospectively reviewed the medical records of outpatients who visited the tertiary hospital. Patients under 18 years of age who underwent endoscopy were included. Endoscopic findings were classified as specific and normal based on gross findings. Specific endoscopic findings were reflux esophagitis, peptic ulcers, and Mallory-Weiss tear. Other findings included acute gastritis classified according to the updated Sydney system.
Results: In 722 of 330,350 patients (0.2%), endoscopic examination (554 esophagogastroduodenoscopies [EGDs], 121 colonoscopies, 47 sigmoidoscopies) was performed between January 2008 and January 2013. In EGD, abdominal pain was the most frequent presentation (64.1%). The most common diagnosis was gastritis (53.2%), followed by reflux esophagitis. The frequency of peptic ulcer disease was 12.8%. Frequent symptoms leading to colonoscopic examination were abdominal pain, diarrhea, and hematochezia. In colonoscopy, a negative result was more likely in children younger than 7 years old. After the procedure, the diagnostic yield of EGD and colonoscopy was 88.1% and 45.8%, respectively, and the rate of change in management was 67.1%.
Conclusions: In pediatrics, endoscopic examination was useful for the choice of therapeutic strategy and it would be a standard method for evaluation of gastrointestinal presentation. **(Korean J Gastroenterol 2014;64:333-339)**

Key Words: Endoscopy; Pediatrics; Abdominal pain

INTRODUCTION

The semi-flexible gastroscope was developed in the early 1930s and fiberoptic endoscopes were popularized in the late 1960s and early 1970s. Video endoscopy was introduced in the 1980s and has developed over the past three decades. The first small-diameter instrument used for esophagogastroduodenoscopy (EGD) in a child was a fiberoptic bronchoscope. Pediatric endoscopic examination of the gastrointestinal tract can be performed in accordance with the dramatic improvements in fiberoptic and video technology.[1] Nowadays, endoscopic examination of pediatric patients may provide essential information for use in diagnosis and management. In general, pediatric endoscopic procedures are safe with a rate of serious complications of less than 1%.[2]

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Although the use of pediatric endoscopy is increasing, adult endoscopists are likely to be called upon by pediatric primary care because pediatric gastroenterologists are not available in many clinical settings. In addition, advanced services such as endoscopic retrograde cholangio-pancreaticography or percutaneous endoscopic gastrectomy were not routinely performed by a pediatric gastroenterologist. Adult endoscopists usually provide advanced endoscopic services for pediatric patients.[3] However, children are not simply young adults. For optimal performance of endoscopy, adequate knowledge and understanding of pediatrics would be required.[4] To date, few studies to evaluate pediatric endoscopy in Korea have been reported. The aim of this study is to investigate the current state and clinical impact of pediatric patients in Korea, and to examine the frequency of changes in medical management resulting from endoscopy.

SUBJECTS AND METHODS

1. Patients

The study was conducted at St. Vincent Hospital (Suwon, Korea) and St. Paul Hospital (Seoul, Korea), the Catholic University of Korea. We retrospectively reviewed the medical records of outpatients who visited the pediatric department between January 2008 and January 2013. The hospital database was searched for all patients in this age group (<18 years) who had undergone an endoscopic examination. We excluded patients with significant co-morbidities such as history of genetic, psychiatric, and developmental disorders because the etiology of pain in these patients likely is different from that of the general population. We also excluded procedures performed in patients with established inflammatory bowel disease (IBD) because the cause the abdominal pain in these cases is assumed to be known.

2. Methods

Prior to endoscopy, we investigated the patients' medical information, including age, gender, clinical presentations, drug history, and birth records. Patients under 5 years old underwent endoscopic examination with small caliber endoscopy (GIF XP260; Olympus Inc., Tokyo, Japan). In the patient group above 6 years old, Olympus video gastroscope (GIF-XQ 240; Olympus Inc.) and Olympus video colonoscope (CF-240 I/CF-H260 AI; Olympus Inc.) were used in performance of the

procedures. Endoscopy findings were classified as specific and normal based on gross findings. In this study, endoscopic Sydney classification system was used for evaluation of alterations of gastric and duodenal mucosal appearance. Endoscopic diagnosis of reflux esophagitis was defined by endoscopic Los Angeles classification of esophagitis. Minimal change reflux esophagitis was also included in this study. Gastric ulcer was defined as gastric mucosal breaks >5 mm in size and depth to the submucosa in the active and healing stage by endoscopy. Duodenal ulcer was defined as duodenal mucosal breaks >5 mm in size and with depth to the submucosa in the active and healing stage by endoscopy. Management change resulting from endoscopy was defined as hospitalization, medication changes, and dietary changes.

3. Statistical analysis

Continuous variables were expressed as mean±standard deviation and compared using Student's t-test. Categorical variables were expressed as percentages and compared using Fisher's exact or chi-square test with SPSS version 12.0 software (SPSS Korea, Seoul, Korea). A p-value less than 0.05 was considered significant.

4. Ethics statement

This study was approved by the Institutional Review Board of the Catholic University of Korea (VC14RISI0022).

RESULTS

Of a total of 330,350 patients, 722 (0.2%) underwent endoscopic examination during the study period. Mean age of the children was 12.8±4.1 years, range 0 month to 18 years: 338 (46.8%) were male and 384 (53.2%) were female. We excluded patients with a history of congenital rubella (1), histiocytosis X (1), annular pancreas (2), and biliary atresia (1). We also excluded procedures performed in patients with previously established chronic disorders such as IBD (6) and chronic pancreatitis (1). Procedures associated with percutaneous endoscopic gastrostomy complication (6) and post-operative/post-procedure follow up (9) were excluded.

1. Esophagogastroduodenoscopy (EGD)

Prior to undergoing endoscopic procedure, 10 symptoms or more were presented. Among symptoms leading to per-

formance of endoscopic examination, abdominal pain was the most common (64.1%), followed by removal of foreign body (9.0%) and nausea/vomiting (9.0%).

Episodes of upper gastrointestinal bleeding—anemia, hematemesis, and melena occurred in 8.2% (Table 1). When the main symptom for performance of the endoscopic examination was abdominal pain, the most common diagnosis was gastritis (53.2%) (Fig. 1), followed by esophagitis (17.7%). When the main symptom was gastrointestinal bleeding, the most common diagnosis was gastritis in pediatrics. Twelve patients (26.7%) had duodenal ulcer and 10 (22.2%) had gastric ulcer. When diagnostic yield was defined based on gross endoscopic findings, it was 88.1% (488/554).

When the patients were divided into two groups according to age above 7 years (＞7 years) or below 7 years (≤7 years), increased frequencies of foreign body and Henoch Scholein purpura were observed in the group below 7 years. In the

group above 7 years, the incidence of gastritis and esophagitis was increased. The incidence of peptic ulcer disease did not show significant differentiation between the two groups (Table 2).

Peptic ulcer disease was confirmed in 71 patients (71/554, 12.8%). In a total of 71 patients with peptic ulcer disease, state of *Helicobacter pylori* infection could be identified in 59 patients who tested with the rapid urease test or silver staining. Positive results of *H. pylori* test were observed in 21 patients (21/59, 35.6%). Among them, 15 patients were prescribed with *H. pylori* eradication therapy. However, the confirmation test for successful eradication of *H. pylori* was not performed in most patients (86.6%).

2. Colonoscopic/sigmoidoscopic examination

A total of 168 patients (121 colonoscopies, 47 sigmoidoscopies) underwent endoscopic examination, giving an overall diagnostic yield of 43.5%. There were no complications related to the procedures. Among the leading symptoms, abdominal pain (37.5%) was the most common, followed by diarrhea (28.0%) and hematochezia (27.4%) (Table 3). Although there were various diagnoses (Fig. 2), 91 patients had normal endoscopic findings. The diagnostic yield was 45.8% (77/168). In patients with chronic colitis (IBD, intestinal tuberculosis), the frequency of abdominal pain as a leading symptom was 35.0% (14/40), whereas it was 36.3% (33/91) in patients with normal colonoscopic findings. There was no significant difference (p=0.89).

When the patients were divided into two groups according to age above 7 years (＞7 years) or below 7 years (≤7 years), only five patients had specific findings in the group below 7

Table 1. Leading Symptoms in Esophagogastroduodenoscopy

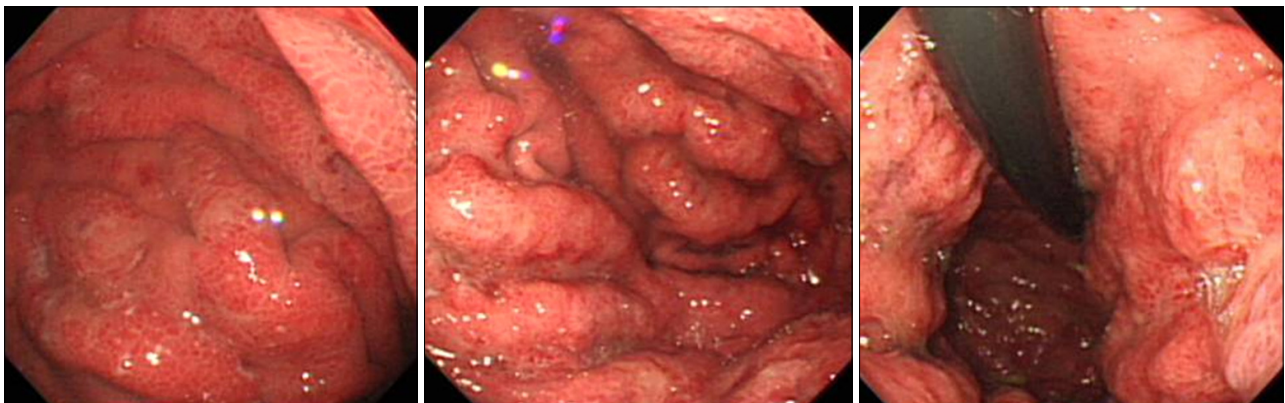| Symptom	Number (%)
Abdominal pain	355 (64.1)
Foreign body sensation	50 (9.0)
Nausea/vomiting	49 (9.0)
Dyspepsia	34 (6.1)
Anemia	17 (3.1)
Hematemesis	17 (3.1)
Melena	11 (2.0)
Acid regurgitation	10 (1.8)
Chest pain	5 (0.9)
Dysphagia	2 (0.3)
Chronic cough	2 (0.3)
Decreased activity	1 (0.2)
Evaluation of upper gastrointestinal bleeding	1 (0.2)
Total	544

Fig. 1. Gastritis was the most common diagnosis of pediatric esophagogastroduodenoscopy; erythematous and edematous mucosal change in the whole stomach.

years. A negative result was more likely in children below 7 years old (76.2%, 16/21). There were no cases of IBD in the group below 7 years (Table 4).

3. Management change

When diagnostic yield was defined based on gross endoscopic findings, it was 88.1%. The overall rate of management change after endoscopic evaluation in children and adolescents was 67.1%. The most common management

change was the addition of drug—histamine 2 receptor antagonist (62.3%) and proton pump inhibitor (27.8%).

DISCUSSION

Pediatric endoscopy has become a valuable tool in the evaluation of gastrointestinal bleeding, dysphagia, abdominal pain, IBD, removal of foreign bodies, and other clinical situations. The indications for gastrointestinal endoscopy in pediatric patients are similar to those for adult endoscopy.[3] In previous reports, abdominal pain is most common in children and adolescents, affecting 13% of middle school students and 17% of high school students.[5] Our results also showed that abdominal pain was the most frequent symptom leading to endoscopic examination. On the contrary, EGD was not recommended for evaluation of chronic abdominal

Table 2. Comparison of Endoscopic Findings in Two Groups according to Age above 7 Years or below 7 Years

Endoscopic finding (%)	Group (yr)		p-value
	≤7 (n=85)	>7 (n=469)	
Gastritis (46.6)	17 (20.0)	241 (51.4)	<0.01[a]
Peptic ulcer (12.8)			
GU	5 (5.9)	22 (4.7)	0.68
DU	2 (2.4)	40 (8.5)	0.12
GU combined DU	1 (1.1)	1 (0.2)	0.17
Reflux esophagitis (15.3)	2 (2.4)	83 (17.7)	<0.01[a]
Foreign body (9.9)	46 (54.1)	9 (2.0)	<0.01[a]
Duodenitis (0.9)	1 (1.1)	4 (0.9)	0.76
Henoch-Schonlein purpura (0.7)	3 (3.5)	1 (0.2)	<0.01[a]
Other (1.8)	2 (2.4)	8 (1.6)	0.68
Normal (11.9)	6 (7.1)	60 (12.8)	0.13

Values are presened as n (%).
GU, gastric ulcer; DU, duodenal ulcer.
[a]The parameters showed significant differentiation between two groups.

Table 3. Leading Symptoms in Colonoscopy and Sigmoidoscopy

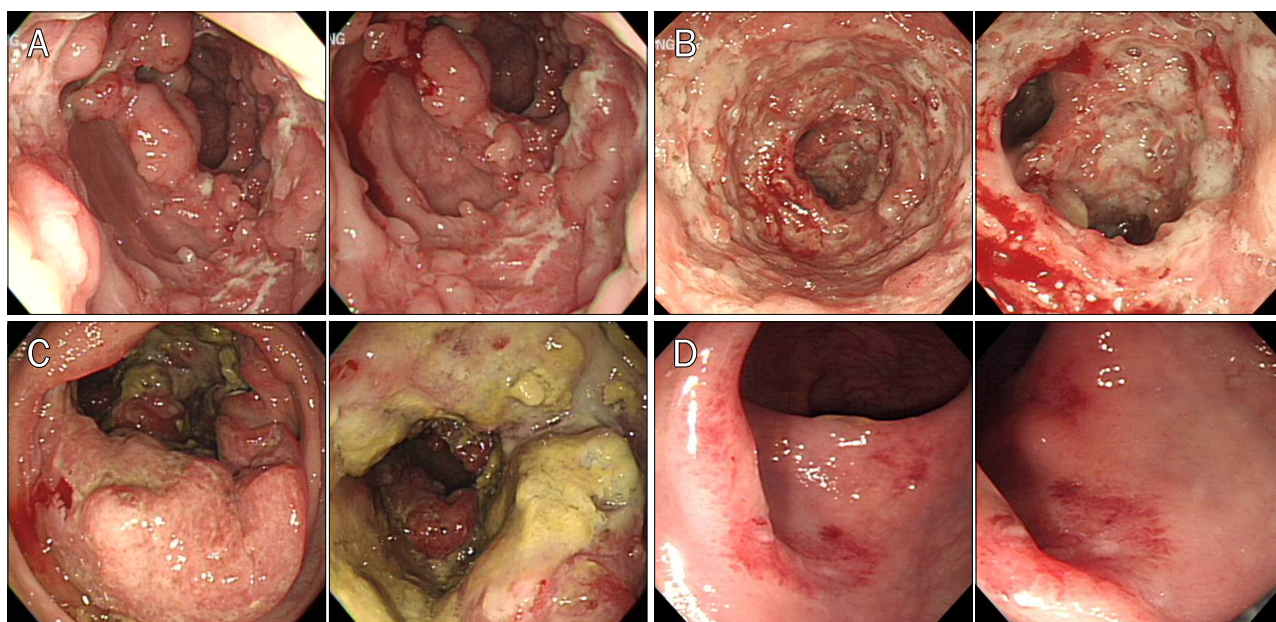| Symptom	Number (%)
Abdominal pain	60 (35.7)
Diarrhea	47 (28.0)
Hematochezia	46 (27.4)
Anemia	7 (4.2)
Constipation	3 (1.8)
Fever of unknown origin	2 (1.2)
Growth retardation	2 (1.2)
Irritability	1 (0.6)
Total	168

Fig. 2. Various findings during pediatric colonoscopy; (A) Crohn's disease, (B) intestinal tuberculosis, (C) lymphoma, (D) rectal ulcer.

Table 4. Comparison of Endoscopic Findings in Two Groups according to Age above 7 Years or below 7 Years

Endoscopic finding (%)	Group (yr)		p-value
	≤7 (n=21)	>7 (n=147)	
Nomal (54.2)	16 (76.2)	75 (51.0)	0.03[a]
Colitis/ileitis/proctitis (14.3)	2 (9.5)	22 (15.0)	0.74
Inflammatory bowel disease (19.6)	0	33 (22.4)	0.01[a]
Crohn's disease	0	21 (14.3)	
Ulcerative colitis	0	12 (8.2)	
Intestinal tuberculosis (4.2)	2 (9.5)	5 (3.4)	0.21
Hemorrhoid (4.2)	0	7 (4.8)	0.59
Polyp (1.8)	1 (4.8)	2 (1.3)	0.33
Rectal ulcer (1.2)	0	2 (1.3)	1.0
Lymphoma (0.6)	0	1 (0.7)	1.0

Values are presened as n (%).
[a]The parameters showed significant differentiation between two groups.

pain in a technical report by the American Academy of Pediatrics and North American Society for Pediatric Gastroenterology, Hepatology and Nutrition (NASPGHAN)[6] and the Rome criteria for childhood functional gastrointestinal disorders did not require a negative endoscopy for diagnosis of abdominal pain-related functional disorders.[7] The diagnostic yield of EGD in children with abdominal pain was only 3.6% in the existing literature.[8] However, there was little evidence to suggest the use of endoscopy and biopsy in evaluation of chronic abdominal pain, and previous data were based on studies which were compromised by small simple size, variable findings, selection bias, and the use of non-standardized diagnostic criteria.

In predicting endoscopic examination, the role of alarm symptoms is still controversial. They are traditionally thought to be associated with organic disease[9] but several alarm symptoms other than vomiting were not significantly predictive of diagnostic yield.[10,11] Alarm symptoms seem to be inaccurate and should not be used for deciding who to select for endoscopic examination among pediatric patients with gastrointestinal symptoms. Our results showed a diagnostic yield based on potential therapeutic or prognostic value— such as peptic ulcer disease and reflux esophagitis of 31.5%. In addition, it was 88.1% when diagnostic yield was defined based on gross endoscopic findings. In review of the medical records to determine whether the management change was after the result of endoscopy, the overall rate of management change after endoscopic evaluation came to more than 60%.

From the clinician's point of view, empirical therapy with anti-secretory agents might be more effective in pediatric patients who complained of specific gastrointestinal symptoms. The reason was that relatively few chronic diseases could be detected by endoscopic examinations in pediatric patients. Nevertheless, in some cases, negative endoscopy would be useful for exclusion of other serious organic disease, and when taking a chance on alternative approaches.

In addition, it could serve as reassurance to the patient and family.[12] Considering technical improvement of endoscopy, quality of life and cost-effectiveness of endoscopic examination, pediatric endoscopy would be a standard method for evaluation of gastrointestinal presentation.

In previous available studies, reflux esophagitis has not been reported as part of the diagnostic yield. It is increasing in prevalence in pediatric patients, and increasing obesity places children and adolescents at higher risk of reflux.[13] Passive tobacco smoke exposure is also a risk factor for esophagitis in children.[14] Based on symptom surveys of reflux esophagitis, children and adolescents have recurrent abdominal pain, whereas only 5% report heartburn sense. Typical symptoms such as heartburn and acid regurgitation are more common in adults.[15] Our results showed that abdominal pain was a frequent presenting symptom of reflux esophagitis, and most of them were endoscopic esophagitis. In cases where children display the atypical symptoms of reflux esophagitis, the physician can make a diagnosis by interviewing the history carefully. In one study, adults with reflux esophagitis were more likely to recall experiencing acid reflux symptoms in childhood, including abdominal pain, recurrent vomiting, dysphagia, chronic cough, or hoarseness.[16] Unfortunately, there was a limitation in this study. Because random biopsies were not taken at the macroscopically unremarkable mucosa of esophagus and duodenum, we might have missed some organic pathology such as eosinophilic esophagitis or Celiac disease. Further studies would be needed in Korean children and adolescents.

Colonoscopy is used for both diagnostic as well as therapeutic purposes in patients with gastrointestinal symptoms. Colonoscopy is generally not useful in children and adolescents because of low diagnostic yield. Chronic abdominal pain is not indicated for colonoscopic examination without alarm symptoms such as weight loss, unexplained fever, short stature, prolonged diarrhea, presence of rectal fis-

sure, abscess and signs of chronic anemia.[6] However, with recent advancement of video technology and colonoscopy technique, pediatric colonoscopy is reasonable in children with acute onset of colitis and negative cultures for bacterial pathogens and parasites. In clinical practice, the most common indications are chronic, stable, irritable bowel syndrome or chronic abdominal pain. In addition, our results showed that the most frequent symptom leading to pediatric colonoscopic examination was abdominal pain. The other causes leading to colonoscopy were diarrhea and hematochezia.[3] The diagnostic yield of colonoscopic examination was 45.8% in pediatrics. However, in our result, abdominal pain was not a symptom potentially indicative of an organic gastrointestinal disease. Interpretation of this result requires caution in drawing conclusions, because we evaluated only one main symptom leading to colonoscopic examination. In addition, cecal intubation time and procedure time of pediatric colonoscopic examination were not evaluated. These were limitations in verification of usefulness of pediatric colonoscopy.

In countries that are becoming westernized, the incidence of IBD is rising. In Japan, Singapore, and South Korea, IBD frequency was initially low but showed a rapid increase. In South Korea, between 1986-1990 and 2001-2005, the incidence of ulcerative colitis increased from 0.3/100,000 to 3.1/100,000 and that of Crohn's disease increased from 0.5/100,000 to 1.3/100,000, respectively.[17,18] IBD can appear at any age, but it is most often diagnosed in young adults. However, the incidence of IBD increases substantially from the age of 10, and increases further among young adults.[19] Our results showed that IBD was extremely rare in children below 7 years, and physicians should be careful in making a diagnosis based on colonoscopic examination with biopsy in children who presented with signs and symptoms of lower gastrointestinal tract.

In conclusion, pediatric endoscopic and colonoscopic examination had a high diagnostic yield with a safe procedure. When the patients had abdominal pain as a presenting symptom, pediatric endoscopic and colonoscopic examinations were valuable procedures. In pediatrics, endoscopic examination was useful for the choice of therapeutic strategy and it would be a standard method for evaluation of gastrointestinal presentation.

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