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Rev Chil Pediatr. 2018;89(3):339-345
DOI: 10.4067/S0370-41062018005000102

ORIGINAL ARTICLE

Description of capsule endoscopy use in a pediatric public hospital

Descripción del uso de cápsula endoscópica en un hospital público pediátrico

María Paz Muñoz[a,e], Álvaro Vega[b], Daniela Lecaros[c], Francisco Saitua[d,e]

[a]Pediatric Gastroenterologist, Gastroenterology Unit, Dr. Luis Calvo Mackenna Hospital
[b]Pediatrician, Dr. Luis Calvo Mackenna Hospital
[c]Pediatrics trainee, Dr. Luis Calvo Mackenna Hospital
[d]Pediatric Surgeon, Surgery Unit, Dr. Luis Calvo Mackenna Hospital
[e]School of Medicine, University of Chile

Received: 28-07-2017; Accepted: 15-02-2018

Abstract

Introduction: Capsule endoscopy (CE) is a non-invasive technique that allows visualization of small intestine mucosa. It is used for diagnosis of lesions not accessible with other tests. Our goal was to describe the experience using CE in a pediatric public hospital in Chile. **Patients and Method:** A retrospective study was carried out to review the cases in which CE was used at Dr. Luis Calvo Mackenna Hospital from 2010 to date. Demographic and clinical data, findings, complications, diagnosis and treatment were recorded. **Results:** Twenty procedures were performed in 16 patients, 11 men (69%), median age 12 years (range 3 to 15 years). Indications included polyposis study (60%), suspected Crohn disease (20%), obscure gastrointestinal bleeding (15%) and undiagnosed anemia (5%). Seventeen studies were altered (85%) and 11 led to a diagnosis or clinical behavior change (55%). There were no complications. **Conclusions:** CE is a useful and safe technique in children, feasible to perform in a pediatric public hospital.

Keywords:
Capsule endoscopy; small intestine; intestinal polyposis; gastrointestinal hemorrhage; Crohn disease

Correspondence:
María Paz Muñoz
pazmunioz@gmail.com

Introduction

Due to the lack of visualization methods, the small intestine was considered the mysterious 'black box' of the gastrointestinal tract. This changed due to the development of the Capsule Endoscopy (CE), a non-invasive technique that allows intraluminal observation of the intestine[1,2], which cannot be done in the same way with other diagnostic tools. These include barium meal, which improves performance with enteroclysis but, unlike the CE, does not generate high-resolution images and requires the administration of ionizing radiation, which limits its application in clinical practice. Likewise, conventional endoscopy has little contributed to the exploration of the small intestine, since oral panendoscopy allows exploration down to the duodenum and with the colonoscopy, in certain cases, only the distal ileum can be reached. Balloon enteroscopy has been an important advance, but it presents technical limitations that make difficult its use in pediatrics[3,4]. In this way, the CE has become a valuable instrument for the diagnosis and follow-up of patients with pathologies of the small intestine mucosa. In addition, it does not produce radiation and may not require sedation or anesthesia, which are important characteristics for use in pediatric age[5].

The CE was first used in humans in 1999 and approved as a diagnostic method in gastroenterology by the U.S. Food and Drug Administration (FDA) in 2001. Subsequently, in 2004 it was approved for use in patients aged 10 to 18 years, and in 2009 in children over two years of age[6]. There are currently three small intestine capsules on the market (PillCam SB, EndoCapsule, and MiRo), one esophageal capsule (PillCam ESO) and one colon capsule available in Europe, the United States, and Japan (PillCam Colon)[7].

The main pathologies that encourage the use of the CE in children are Crohn's disease, gastrointestinal bleeding, anemia of unknown origin, diarrhea, abdominal pain, and polyposis study[8]. Positive findings have been reported in the small intestine most of the times when it is used, similar to what has been observed in adults, which in turn has demonstrated impact in the diagnosis and treatment of patients with diverse intestinal disorders[9,10].

Global experience shows that this is a useful, well-tolerated and safe technique with a low complication rate[11]. However, the high cost and low availability of this exam mean that it is not very frequent in our country. So far there is only one report on its use in our country, which includes mostly adult patients in a private health center[12], while there are no data on the pediatric population or public hospitals. This technique is available since 2010 at the Dr. Luis Calvo Mackenna Hospital. The objective of this study is to describe the experience of the use of CE in a public pediatric hospital in Chile.

Patients and Methods

Design

Retrospective study approved by the Ethics Committee in Research on Human Subjects of the School of Medicine of the University of Chile. All cases were reviewed in which the CE was used as a diagnostic study at the Dr. Luis Calvo Mackenna Hospital from the beginning of its use in 2010 to date. Each procedure was considered individually. The clinical records of the patients were reviewed from which the demographic data, medical history, diagnosis, indication and technique of CE, test findings, complications associated with the procedure up to two weeks after it was performed, definitive diagnosis and associated behavior were obtained.

Instrument

A PillCam™ SB 3 Capsule (Given Imaging, Israel) was used to perform the study according to the recommendations of the manufacturer. The system consists of a 26 x 11 mm disposable capsule with a light source and a lens that captures high-resolution images. The rate of image capture is variable and automatically set; it increases to six frames per second when the capsule moves quickly, as in the duodenal sweep, and decreases to two frames per second when it moves slowly or when it stops. The images are transmitted by radio frequency to a recording device carried by the patient along with a battery as a belt[4]. In addition to recording, the equipment allows viewing the images in real time during the examination. Once the test is completed, the record is transferred to a workstation and analyzed by a trained operator using a software.

Contraindications include conditions that prevent the passage of the capsule through the digestive tract such as stenosis, fistulas or intestinal obstruction[6]. Its safety in pregnancy has not been proven. Initially the use of pacemakers was considered a contraindication, however, later studies report that the CE does not interfere with pacemakers and vice versa, therefore, currently in these cases it is recommended to use them without special precautions[13].

Characteristics of the procedure

The procedure is performed in a daytime hospitalization with ten hours of fasting without further preparation. The capsule can be swallowed or installed by endoscopy with a release device and then pushed through peristalsis until it is expelled through the stools. Two hours after the start of the test, the patient

can drink clear liquids and four hours after the start of the test, normal diet and medications. After 8 to 12 hours of recording, after confirmation of the capsule transition to the cecum through snapshot view, the sensors are disconnected and the patient can be discharged. Accompanying persons are instructed to ensure that the capsule is expelled through the stools and to consult if this does not occur within a period of more than one week in order to carry out an abdominal x-ray to confirm or rule out the presence of the capsule. The video review, the selection of representative images and make a report can take 30 to 120 minutes. In this study, this procedure was done by the same professional in all patients.

Statistical analysis

The information obtained was entered into a database in Excel format. To characterize the variables of interest, descriptive statistics were used. For the quantitative variables, measures of central tendency and dispersion were used. Qualitative variables are presented in absolute numbers and relative frequency.

Results

From 2010 to date the CE has been used 20 times in 16 patients. Table 1 shows the characteristics of the patients and procedures performed. The median age was 12 years (range 3 to 15 years). On seven occasions the patient swallowed the capsule and the rest were installed by endoscopy. In the group that swallowed it, all patients were over 12 years old. Indications for the test included study of polyposis (60%), suspected Crohn's disease (20%), gastrointestinal bleeding of unknown origin (15%) and anemia of unknown cause (5%). Among the patients, there are five of them with medical history of intestinal surgeries; in one of them, the CE was used twice. In the 20 studies, the entire small intestine was observed; in 17 of them, some pathological finding was found (85%) and in 11 occasions the use of CE allowed to make a diagnosis or led to a change in clinical behavior (55%). There were no trappings or other complications associated with the procedure. In all patients, the capsule was expelled through the stools within two weeks of installation.

Table 2 shows the 20 procedures performed. The CE was used 12 times in eight patients in order to assess the presence of polyps in any of the segments of the small intestine, which had not been achieved with other imaging methods. Polyps were observed in ten of these studies. The procedure was performed more than once on patients with diseases that require periodic follow-up. Among the patients, there were two of them with familial adenomatous polyposis, one of which the CE has been used twice, with polyps smaller than 10 mm observed in all studies, leading to continued follow-up. It was also used eight times in five patients with suspicion or known diagnosis of Peutz-Jeghers syndrome. On three occasions no polyps were observed or they were smaller than 10 mm, therefore, the follow-up was maintained, while on the remaining five occasions, the finding of polyps larger than 10 mm led to polypectomy, in which polyps compatible with hamartomas were resected. Out of the five polypectomies, three were performed by enteroscopy and two by ileoscopy depending on the location of the polyps to be resected. One of the patients presented clinical suspicion of Peutz-Jeghers syndrome without finding polyps in the endoscopic study, however, the CE did not show polyps either, therefore, the patient continued in follow-up.

All four patients with suspected Crohn's disease had previously inconclusive endoscopic studies. In three of them, the CE showed findings suggestive of the disease, thus, the study continued; in one of them the diagnosis of Crohn's disease was made, and in another one of food allergy, medical treatment was initiated in both of them with good response; in the last one no definitive diagnosis was made and the patient continued in follow-up. In the remaining patient, who had previously been diagnosed with autoimmune hepatitis and had clinical suspicion of Crohn's disease, the CE and the rest of the study were negative, therefore, it was ruled out and the patient is still in follow-up due to his base disease.

Table 1. Characteristics of patients and procedures performed

Number of patients	16
Median age years (range)	12 (3-15)
Men (%)	11 (69)
Previous intestinal surgeries (%)	5 (31)
Number of procedures	20
Installation method	
Endoscopy (%)	13 (65)
Swallowing (%)	7 (35)
Indications	
Study of polyposis (%)	12 (60)
Suspected Crohn's disease (%)	4 (20)
Gastrointestinal bleeding (%)	3 (15)
Anemia (%)	1 (5)
Pathological findings (%)	17 (85)
Diagnosis or change of clinical behavior (%)	11 (55)
Complications	0

Table 2. Details of the procedures performed

Patient†	Age (years)	Previous intestinal surgeries	Indication	Installation	Findings	Clinical behavior change	Diagnosis
1	6	No	Polyposis study	Endoscopy	Polyps in duodenum < 10 mm	No, follow-up	Familial adenomatous polyposis
2 (1)	12	No	Polyposis study	Swallowing	Polyps in jejunum < 5 mm	No, follow-up	Familial adenomatous polyposis
2 (2)	13	No	Polyposis study	Endoscopy	Polyps in jejunum < 5 mm	No, follow-up	Familial adenomatous polyposis
3	3	Bowel resection	Polyposis study	Endoscopy	Erosions in duodenum	No, follow-up	Peutz-Jeghers syndrome
4	7	No	Polyposis study	Endoscopy	Polyps in duodenum > 10 mm, jejunum, ileum < 5 mm	Yes, enteroscopy with polypectomy	Peutz-Jeghers syndrome
5	12	No	Polyposis study	Endoscopy	Polyps in duodenum, jejunum < 5 mm, ileum > 10 mm	Yes, ileoscopy with polypectomy	Peutz-Jeghers syndrome
6 (1)	9	Intussusception Polypectomy	Polyposis study	Endoscopy	Polyps in ileum < 5 mm	No, follow-up	Peutz-Jeghers syndrome
6 (2)	14	Intussusception Polypectomy	Polyposis study	Swallowing	Polyps in duodenum, jejunum, ileum > 10 mm	Yes, enteroscopy with polypectomy	Peutz-Jeghers syndrome
7 (1)	8	No	Polyposis study	Endoscopy	Polyps in jejunum, ileum > 10 mm	Yes, enteroscopy with polypectomy	Peutz-Jeghers syndrome
7 (2)	9	No	Polyposis study	Endoscopy	Polyps in jejunum, ileum < 5 mm	No, follow-up	Peutz-Jeghers syndrome
7 (3)	12	No	Polyposis study	Endoscopy	Polyps in duodenum < 5 mm, ileum > 10 mm	Yes, ileoscopy with polypectomy	Peutz-Jeghers syndrome
8	13	No	Polyposis study	Swallowing	Normal	No, follow-up	No diagnosis
9	14	No	Sospecha de EC	Swallowing	Patchy lymphangiectasia Erosions in jejunum, ileum	Yes, additional study	Crohn's disease
10	14	No	Suspected CD	Swallowing	Erosions and ulcers in jejunum	Yes, additional study	Food allergy
11	14	No	Suspected CD	Endoscopy	Patchy lymphangiectasia Angioectasia in duodenum	Yes, additional study	No diagnosis
12	13	No	Suspected CD	Swallowing	Normal	No, follow-up	Autoimmune hepatitis
13	15	Ileostomy Biliodigestive derivation	Gastroin-testinal bleeding	Swallowing	Active bleeding in ileum	Yes, exploratory laparotomy	Ulcer in ileum
14	5	Kasai portoen-terostomy Liver transplantation	Gastroin-testinal bleeding	Endoscopy	Diffuse intestinal angiodysplasia	Yes, treatment start	Diffuse intestinal angiodysplasia
15	5	Pull-through	Gastroin-testinal bleeding	Endoscopy	Erosions in duodenum No active bleeding	No, follow-up	Resolved bleeding, cause not specified
16	14	No	Anemia	Endoscopy	Normal	Yes, additional study	Gynecological bleeding

†In case of having more than one exam. CD: Crohn's disease.

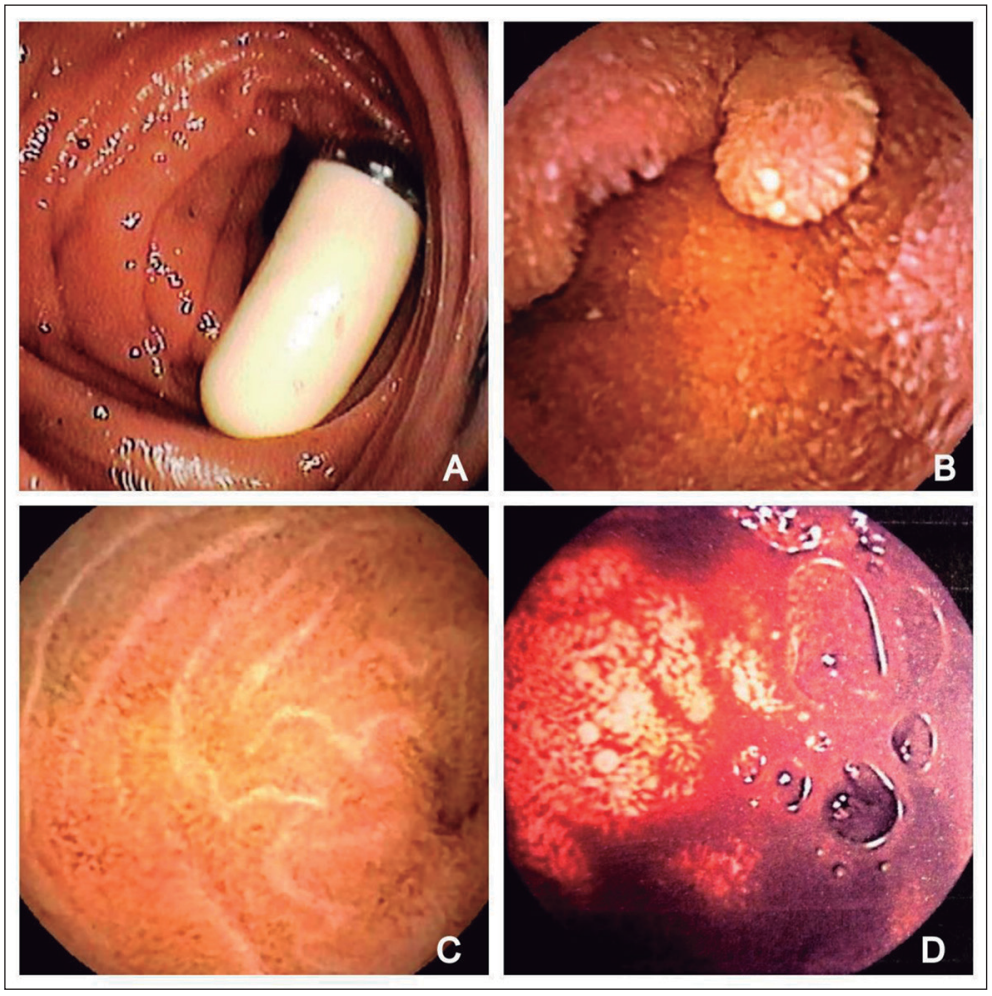

Figure 1. A) Capsule endoscopy in duodenum. **B)** Polyp in ileum. **C)** Linear ulcers in jejunum. **D)** Active bleeding in ileum.

In three patients with gastrointestinal bleeding, CE was used after no diagnosis was reached with endoscopic and imaging studies. In one of them, active bleeding was observed in the ileum, in which an exploratory laparotomy was performed, where it was found a bleeding ulcer of unspecified etiology and hemostasis was performed with good response; in another patient, a diffuse intestinal angiodysplasia was found, thus, medical treatment with thalidomide was started, and in the last one, old duodenal erosions were found that did not explain the clinical picture; afterwards, bleeding stopped without finding the cause and it did not happen again. In the patient with anemia of unknown cause, the CE was normal, thus the study was continued and the diagnosis of bleeding anemia of gynecological origin was made which was treated with good response.

Figure 1 shows the capsule after installation and some of the most relevant findings observed.

Discussion

This retrospective review of the use of CE for seven years in a pediatric public hospital is the first of its kind in the national literature. Although it corresponds to a series of few cases in relation to those reported in foreign series, we consider it relevant to communicate this experience since, despite being a useful and safe procedure, it is not frequently used in our sphere for cost and availability reasons.

Patients from the age of three were included in this series, which corresponds to the authorization for use of this test from the age of two years, although it has been reported in patients from ten months and 7.9 kg[14]. It has been reported that most of the patients (84%) swallow the capsule[8]. In this case, 65% of the times it was installed endoscopically. It is important to mention that this route was chosen in patients undergoing endoscopy as part of the diagnostic study, alt-

hough several of them may have swallowed it without problems. Among the patients who swallowed it, the youngest was 12 years old, although this has been reported in children as young as four years old[15].

A meta-analysis reviewing 740 procedures of CE use in children under 18 years of age[8] showed that the indications for its use were study or follow-up of Crohn's disease (54%), gastrointestinal bleeding or anemia of unknown cause (17%), abdominal pain and diarrhea (13%), polyposis (11%), and other gastrointestinal pathologies (5%). In this series, it was mainly performed for the study of polyposis. This difference could be explained by the fact that the low availability of the test means that it is used in cases of Crohn's disease with complex diagnosis, after the usual diagnostic methods. On the other hand, in cases of suspected small intestine polyps, the other tests available do not allow an adequate study, which may lead to a more frequent use.

As mentioned above, 85% of the procedures performed showed pathological findings. This performance is higher than that reported in the literature, which reports 54% of cases[16]. Due to it is a limited access test, patient selection may be more rigorous, which may explain the performance described. On the other hand, it should be noted that the pathological findings do not necessarily imply a diagnosis or a change in the clinical behavior, which occurred in 55% of cases, including one case where the examination was normal.

It has been reported that the capsule does not reach the cecum in approximately 16% of cases, which occurs more frequently in patients with previous small intestine surgeries, hospitalized, with poor bowel cleansing and intestinal transit time of more than 45 minutes[17]. While this series included some patients with the risk factors described, all studies were completed.

As mentioned above, the CE is used to visualize the mucosa of the small intestine, which is not possible with the usual endoscopic study. As an alternative, the use of balloon enteroscopy could be considered, which, in addition to being a diagnostic method, has the advantage of tissue sampling and therapeutic intervention. Despite this, the use of CE was chosen because it is a non-invasive test that allows the study of the majority of the mucosa, which is not possible with the enteroscopy, which is also a more complex technique, not well tolerated and has little application in pediatrics due to the lack of material adapted to this group of patients[18,19]. In this series, the findings led to an enteroscopy in three of the 20 procedures performed, which supports the use of CE.

The main complication associated with the procedure is the retention of the capsule, which is defined as not expelling it for two weeks after its installation, or the need to intervene for its removal in a shorter period of time[20]. A systematic review conducted in adults which included 22,840 procedures reported a retention rate of 2.1%, with an increased risk in patients with prolonged use of non-steroidal anti-inflammatory drugs, abdominal radiotherapy, extensive Crohn's disease, abdominal surgery, or bowel resection[9]. The two largest pediatric studies, which included 284 and 207 patients, reported retention rates of 1.8% and 1.4% respectively[17,21]. The latter study reported that pediatric patients with the highest risk of retention were those with known inflammatory bowel disease and body mass index below the 5th percentile for age[22]. In this series, five patients had previous bowel surgeries, in whom the risk of retention could be higher. This should be considered before indicating CE but is not considered an absolute contraindication in the absence of previous obstructive symptoms[4].

In patients at risk of retention, it is possible to use a patency capsule, which consists of a capsule composed of an absorbable material, barium-filled, with the same dimensions and shape as the standard capsule, designed to remain undamaged in the gastrointestinal tract for approximately 30 (Agile©) or 80 hours (Patency©). If it has not been expelled after this period, it disintegrates spontaneously. The permanence within the body can be verified by radiology or radio frequency and contraindicates the use of a 'real' CE. The accuracy of the patency capsule for predicting retention in adults has been reported to be close to 100%[4].

There were no complications in this series. While this confirms that this is a safe test, it is possibly explained by the number of studies performed, since as mentioned before, the most frequent complication occurs in about 2% of cases, that is to say, one out of 50 procedures.

We consider that this series of cases shows that CE is a useful and safe technique in children, in accordance with what has been reported in the literature, besides being feasible to perform in a public pediatric hospital as part of the study of gastrointestinal pathology.

Ethical responsibilities

Human Beings and animals protection: Disclosure the authors state that the procedures were followed according to the Declaration of Helsinki and the World Medical Association regarding human experimentation developed for the medical community.

Data confidentiality: The authors state that they have followed the protocols of their Center and Local regulations on the publication of patient data.

Rights to privacy and informed consent: The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the correspondence author.

Financial Disclosure

Authors state that no economic support has been associated with the present study.

Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

References

1. Iddan G, Meron G, Glukhovsky A, Swain P. Wireless capsule endoscopy. Nature 2000;405:417.
2. de' Angelis GL, Fornaroli F, de' Angelis N, Magiteri B, Bizzarri B. Wireless capsule endoscopy for pediatric small-bowel diseases. Am J Gastroenterol 2007;102:1749-57.
3. Argüelles-Martín F, Domínguez-Pérez AJ. Cápsula endoscópica en pediatría. Vox Paediatrica 2014;21:54-9.
4. Argüelles-Arias F, Donat E, Fernández-Urien I, et al. Guideline for wireless capsule endoscopy in children and adolescents: A consensus document by the SEGHNP (Spanish Society for Pediatric Gastroenterology, Hepatology, and Nutrition) and the SEPD (Spanish Society for Digestive Diseases). Rev Esp Enferm Dig 2015;107:714-31.
5. Oliva S, Cohen SA, Di Nardo G, Gualdi G, Cucchiara S, Casciani E. Capsule endoscopy in pediatrics: A 10-years journey. World J Gastroenterol 2014;20:16603-8.
6. Friedlander JA, Liu QY, Sahn B, et al. NASPGHAN Capsule Endoscopy Clinical Report. J Pediatr Gastroenterol Nutr 2017;64:485-94.
7. ASGE Technology Committee, Wang A, Banerjee S, Barth BA, et al. Wireless capsule endoscopy. Gastrointest Endosc 2013;78:805-15.
8. Cohen SA, Klevens AI. Use of capsule endoscopy in diagnosis and management of pediatric patients, based on meta-analysis. Clin Gastroenterol Hepatol 2011;9:490-6.
9. Liao Z, Gao R, Xu C, Li ZS. Indications and detection, completion, and retention rates of small-bowel capsule endoscopy: a systematic review. Gastrointest Endosc 2010;71:280-6.
10. Ahmad NA, Iqbal N, Joyce A. Clinical impact of capsule endoscopy on management of gastrointestinal disorders. Clin Gastroenterol Hepatol 2008;6:433-7.
11. Zevit N, Shamir R. Wireless Capsule Endoscopy of the Small Intestine in Children. J Pediatr Gastroenterol Nutr 2015;60:696-701.
12. Sanhueza E, Ibáñez P, Araya R, et al. Utilidad de la cápsula endoscópica como método diagnóstico en el estudio de intestino delgado. Rev Med Chile 2010;138:303-8.
13. Enns RA, Hookey L, Armstrong D, et al. Clinical Practice Guidelines for the Use of Video Capsule Endoscopy. Gastroenterology 2017;152:497-514.
14. Oikawa-Kawamoto M, Sogo T, Yamaguchi T, et al. Safety and utility of capsule endoscopy for infants and young children. World J Gastroenterol 2013;19:8342-8.
15. Fritscher-Ravens A, Scherbakov P, Bufler P, et al. The feasibility of wireless capsule endoscopy in detecting small intestinal pathology in children under the age of 8 years: a multicentre European study. Gut 2009;58:1467-72.
16. Cohen SA, Ephrath H, Lewis JD. Pediatric capsule endoscopy: review of the small bowel and patency capsules. J Pediatr Gastroenterol Nutr 2012;54:409-13.
17. Westerhof J, Weersma RK, Koornstra JJ. Risk factors for incomplete small-bowel capsule endoscopy. Gastrointest Endosc 2009;69:74-80.
18. de Leusse A, Vahedi K, Edery J, et al. Capsule endoscopy or push enteroscopy for first-line exploration of obscure gastrointestinal bleeding? Gastroenterology 2007;132:855-62.
19. Saurin JC, Delvaux M, Vahedi K, et al. Clinical impact of capsule endoscopy compared to push enteroscopy: 1-year follow-up study. Endoscopy 2005;37:318-23.
20. Cave D, Legnani P, de Franchis R, Lewis BS. ICEE consensus for capsule retention. Endoscopy 2005;37:1065-7.
21. Atay O, Mahajan L, Kay M, Mohr F, Kaplan B, Wyllie R. Risk of capsule endoscope retention in pediatric patients: a large single-center experience and review of the literature. J Pediatr Gastroenterol Nutr 2009;49:196-201.