Observational Study

Medicine®

OPEN

Sonographic diagnosis of colorectal polyps in children

Diagnostic accuracy and multi-factor combination evaluation

Ni-Na Qu, MD[a,b], Rui-Hua Liu, MD[a], Lei Shi, MD[a], Xiao-Li Cao, MD[a], Yong-Jun Yang, MD[c], Jie Li, MD[b,*]

Abstract

This study was established to evaluate the diagnostic value of ultrasonography in screening colorectal polyps in children and to discuss the necessity of colonic preparation before an ultrasonic examination.

In this study, 288 children with colorectal polyps managed at our hospital between January 2007 and December 2016 were retrospectively reviewed. All patients were examined before and after basic colon preparation. The colorectal polyps were confirmed by colonoscopy/laparotomy and histopathology. Among all 288 patients, solitary polyps were identified in 278 patients (96.52%), and multiple polyps were identified in 10 patients (43 polyps) (3.48%) by colonoscopy/laparotomy and histopathology.

By ultrasonic examination, 264 cases (264/278) were detected as solitary polyp and 9 cases (9/10) as multiple polyps (31 polyps). In 278 solitary polyps, 180 (64.74%) were detected by ultrasonic examination without a colon preparation. Following glycerine enema (10–20 mL) treatment, 264 (94.96%) cases were detected by ultrasonic examination. The sensitivity and specificity of ultrasonography with glycerine enema for the detection of colorectal polyps were 94.96% and 100%, respectively. Colon preparation significantly increased the proportion of polyps identified by ultrasonography ($P < .0001$), as well as the diagnostic rate of polyps in rectum, sigmoid colon and descending colon ($P < .05$).

Ultrasonography can be the primary diagnostic method for screening colorectal polyps in children on the strength of its safety, validity, and accuracy. Basic colon preparation with glycerine enema is recommended for children, which enable the detection of intraluminal lesions before ultrasonic examination.

Abbreviation: 2D = 2-dimensional.

Keywords: colorectal polyp, multi-factor combination, pediatrics, ultrasonography

1. Introduction

Colorectal polyp is the most common type of gastrointestinal polyps in children, accounting for 90% of all cases,[1] usually manifesting with painless rectal bleeding. The associated symptoms include recurrent abdominal pain, diarrhea, and prolapse through the anus.[2] Full colonoscopy is the common standard for the diagnosis and treatment of colorectal polyps.[3] Digital rectal examination[4] and air-contrast barium enema[5] are typically used to confirm the diagnosis before colonoscopy and laparotomy, but their detection rates were relatively low.[6]

Technological advances have revolutionized sonography with better detection capability, and therefore sonography is nowadays used as an imaging modality for evaluating colonic polyps.[7] Previously, some studies recommended the application of graded compression sonography without colon preparation,[7,8] while others suggested that colonic infusion with saline helps the detection of intraluminal lesions.[9] Because these previous reports are sporadic and inconsistent, the importance of colon preparation remains unclear, neither for the importance of the sonographers' technology dependence and standard ultrasound scan protocol. Therefore, a systematic study in a large cohort of samples is needed for a better guide for sonography practice during the diagnosis of colorectal polyps.

The purpose of this study was to reveal the validity of ultrasonic diagnosis of child colorectal polyps through a retrospective analysis of cases in our center, especially to discuss whether the combination of multi-factors (sonographers' technology dependence, standard ultrasound scan protocol and basic colon preparation) is needed for children suspected with polyps under an ultrasonic examination.

2. Materials and methods

2.1. Patients

From January 2007 to December 2016, the clinical data of 288 children diagnosed with colorectal polyps and managed in the Pediatric Surgery Department of our hospital were retrospective-

Editor: Yan Li.

This work was funded by National Natural Science Foundation of China (grant number 81771843); Science and Technology Developing Program of Shandong Provincial Government of China (grant number 2017GSF18107); and Shandong Natural Science Foundation of China (grant number ZR2014HL087).

The authors declare no conflicts of interest.

[a] Department of Ultrasound, Affiliated Yantai Yuhuangding Hospital of Qingdao University, [b] Department of Ultrasound, Qilu Hospital of Shandong University, [c] Ultrasound Department, Second Hospital of Shandong University, Jinan, China.

[*] Correspondence: Jie Li, Department of Ultrasound, Qilu Hospital of Shandong University, 107 Wenhua Xi Road, Jinan 250012, China (e-mail: jielisdu@126.com).

Medicine (2018) 97:39(e12562)

Received: 28 March 2018 / Accepted: 5 September 2018

http://dx.doi.org/10.1097/MD.0000000000012562

ly analyzed. This study was approved by the Ethics Committee of Yantai Yuhuangding Hospital. Informed consent was obtained from all participants and their guardians.

Patients' general information (age and gender), clinical symptoms and signs, ultrasonic image characteristics (size of polyp, number, location, internal echo, color Doppler, and presence of a pedicle-like echo), colonoscopy/laparotomy findings (polyp size, number, and location), and histopathological results were collected.

2.2. Colon preparation and ultrasonic examination

All patients were examined twice by ultrasonography under standard scan protocol with or without basic colon preparation. Ultrasonography was performed with a Philips iU22 device (Philips Medical Systems, Bothell, WA) and a GE LOGIQ9 device (GE Healthcare, Milwaukee, WI), using a 6 to 12 MHz linear array probe and a 2 to 5 MHz convex array probe. Each abdominal scan was performed carefully by 2 experienced pediatric ultrasonic diagnosticians using both high-frequency and low-frequency probes. If the diagnoses from the 2 examiners were inconsistent, a third senior ultrasonic diagnostician would join the consultation, and a final conclusion was made.

The first ultrasonic examination was complete abdominal ultrasonic scan without any colon preparation. Before the second examination, 10 and 20 mL glycerine enema was anally administered to completely empty the patient's colon, especially descending colon, sigmoid flexure and rectum where most polyps were commonly located.[10] None of the patients was subjected to fasting or anal injection of water. Patients younger than 3 years old or those who could not cooperate were given a single oral dose (50 mg/kg) of chloral hydrate as a sedative 30 minutes before the examination.

The colon is usually identified in the periphery of the abdomen, showing haustra, intraluminal gas, and/or stool and little peristalsis. Two ultrasonic diagnosticians tested 288 patients using the following standard scan protocol: examination of the colon started at the cecum and ileocecal valve and extended to the ascending, transverse, descending colon, sigmoid flexure, and rectum. Transverse ultrasonographic scan was performed across the whole colon, with the transducer placed perpendicularly to the colon. Because the rectum and its distal portion are deep in the abdominal cavity, they were examined from the pelvic and the anus. If an area of concern in the bowel was identified, it was scanned in different angles and planes and Doppler interrogation of the region of interest was performed. Standard sections included: the 2-dimensional (2D) image of the polyp and the polyp pedicle; measurement of the lengths of the long and short axis of the polyp by the cursor attached to the ultrasonographic device; and the color Doppler image of the polyp and the polyp pedicle.

2.3. Colonoscopy and histological examination

All children underwent a full colonoscopy under general anesthesia, followed by histologic examination.

2.4. Statistical analyses

SPSS 20.0 software (IBM, Armonk, NY) was used to analyze the data. χ^2 test was used for comparisons of differences between groups. $P < .05$ indicated that the difference was statistically significant.

Table 1

The clinical manifestations distribution of 288 patients with colorectal polyps.

	n	%
Rectal bleeding	276	95.83
Abdominal pain	36	12.50
Diarrhea	12	4.17
Anemia	25	8.68

3. Results

3.1. General clinical data of all patients

Between January 2007 and December 2016, colorectal polyps were identified in 288 children (181 boys and 107 girls) with an average age of 4.3 ± 2.1 years by colonoscopy or surgery. The main clinical features were summarized in Table 1. Hematochezia was the most common symptom observed in 276 (95.83%) children. The clinical manifestation varied from streaks of blood in the stool to drops of fresh blood after defecation. Associated symptoms included abdominal pain (n = 36, 12.50%), diarrhea (n = 12, 4.17%), and anemia (hemoglobin < 110 g/L, n = 25, 8.68%).

3.2. Comparison of ultrasonography and colonoscopy in the diagnosis of colorectal polyps

All patients underwent a full colonoscopy or surgery under general anesthesia, including 2 children with polyps fallen off spontaneously after colon preparation, only the pedicles of those polyps were identified during the colonoscopy. Among the 288 patients, 278 patients (278/288, 96.52%) had solitary polyp, whereas 10 patients (10/288, 3.48%) had more than 1 polyp (43 polyps). The distribution and the frequency of solitary colorectal polyps in 278 children were shown in Figure 1. Table 2 summarized the 10 patients with multiple polyps. During ultrasonic examination, 264 cases were detected as solitary polyp and 9 cases as multiple polyps (31 polyps). The sensitivity of ultrasonography with/without glycerine enema for the detection of colorectal polyps was shown in Table 3. The ultrasonic findings (before and after the colon preparation) and colonoscopic findings of solitary colorectal polyps in children were shown in Table 4. Based on other indications for

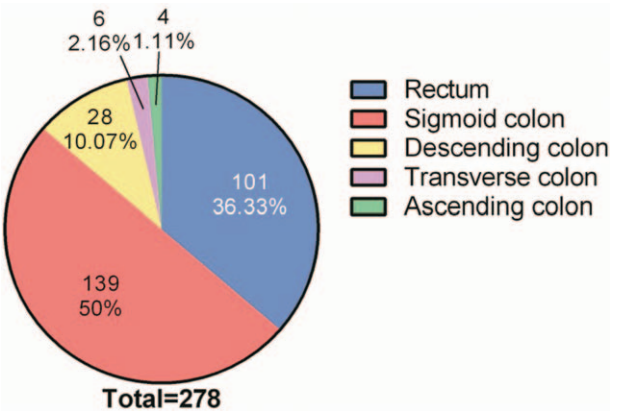

Figure 1. The distribution of solitary colorectal polyps in 278 children.

Table 2

The clinical presentation, sonographic findings and postoperative findings in 10 cases with multiple polyps.

Case	Gender	Age, y	Clinical features	Location and number of polyps		Treatment	Pathology
				Sonographic findings, n	Colonoscopic/surgical findings, n		
1	M	3	Hematochezia	Rectum (2), descending colon (2)	Rectum (2), sigmoid colon (1), descending colon (3)	Colonoscopy	Juvenile polyposis
2	M	10	Hematochezia, family history of polyps	Rescending colon (3)	Sigmoid colon (1), descending colon (3)	Colonoscopy	Familial adenomatous polyposis
3	F	2	Abdominal pain	Rectum (1), sigmoid colon (2), descending colon (1)	Rectum (1), sigmoid colon (2), descending colon (1)	Colonoscopy	Juvenile polyposis
4	M	4	Mucosanguineous feces and diarrhea	Rectum (2), descending colon (2)	Rectum (2), descending colon (2), transverse colon (1)	Laparotomy	Juvenile polyposis
5	F	3	Hematochezia with family history of polyps	Descending colon (3)	Descending colon (3)	Colonoscopy	Juvenile polyps
6	F	5	Abdominal pain, lip and finger pigmentation	Rectum (1), sigmoid colon (1), descending colon (1)	Rectum (1), sigmoid colon (2), descending colon (2)	Laparotomy	Peutz-Jeghers syndrome
7	M	7	Hematochezia and diarrhea	0	Transverse colon (1), ascending colon (2)	Laparotomy	Peutz-Jeghers syndrome
8	M	11	Lip and finger pigmentation	Rectum (1), sigmoid colon (1), descending colon (1)	Rectum (1), sigmoid colon (1), descending colon (3)	Laparotomy	Peutz-Jeghers syndrome
9	M	5	Abdominal pain with family history of polyps	Rectum (1), descending colon (2)	Rectum (1), descending colon (2)	Colonoscopy	Juvenile polyposis
10	F	7	Lip and finger pigmentation	Rectum (1), descending colon (3)	Rectum (1), descending colon (3), transverse colon (1)	Laparotomy	Peutz-Jeghers syndrome

F = female, M = male.

Table 3

The detection sensitivity of ultrasonography with /without glycerine enema for colorectal polyps.

		Solitary colorectal polyps		Multiple colorectal polyps		Total	
		N	Sensitivity	N	Sensitivity	N	Sensitivity
Ultrasonic findings	Without glycerine enema	180	64.74%	9	90%	189	65.60%
	With glycerine enema	264	94.96%	9	90%	273	94.79%
Colonoscopic findings		278	–	10	–	288	–

colonoscopy, 14 patients with negative ultrasonic examination results underwent a colonoscopy and were confirmed to have polyps. There were 84 cases of polyps diagnosed differently by ultrasonography before and after basic colonic preparation. Their distribution in the intestine and age group were summarized in Table 5.

The common ultrasonic feature of all polyps was an intraluminal isolated hypoechoic nodule with a hyperechoic

Table 4

The ultrasonic findings (before and after the colon preparation) and colonoscopic findings of solitary colorectal polyps in children.

Polyp location	Ultrasonic findings				Colonoscopic findings
	Before colon preparation		After colon preparation		
	n	%	n	%	n
Rectum	64	63.37*	98	97.03*	101
Sigmoid colon	93	66.91†	135	97.12†	139
Descending colon	18	64.28‡	26	92.86‡	28
Transverse colon	3	50.00	3	50	6
Ascending colon	2	50.00	2	50	4
Total	180	64.74§	264	94.96§	278

* $\chi^2=36.03$, $P<.0001$.
† $\chi^2=43.02$, $P<.0001$.
‡ $\chi^2=6.78$, $P=.02$.
§ $\chi^2=74.094$, $P<.0001$.

Table 5

The number and age group of children with solitary colorectal polyps diagnosed differently by ultrasonography before and after glycerine enema colon preparation.

Location	Total number*	Age, y			
		0–3	3–6	6–9	9–12
Rectum	34 (98–64)	2	3	19	10
Sigmoid colon	42 (135–93)	5	16	11	10
Descending colon	8 (26–18)	0	3	2	3
Transverse colon	0 (3–3)	0	0	0	0
Ascending colon	0 (2–2)	0	0	0	0
Total	84 (264–180)	7	22	32	23

* Number of cases diagnosed after colon preparation–before colon preparation by ultrasonography.

layer (Fig. 2A), and cysts (Fig. 3A) of different sizes were visualized in the polyps. Blood flow was easily identified within these polyps by color Doppler sonography (Fig. 2B), which might facilitate the identification of a vascular pedicle coursing through the pedicle of the polyp. The ultrasonography duration ranged from 10 to 30 minutes (15.2 ± 3.8 mins). Comparison of the ultrasonic images of solitary juvenile polyp in the splenic flexure of the colon before and after glycerine enema treatment is shown in Figure 4.

3.3. The histopathological examination results of 288 patients

The histopathological examination results of 288 patients were available for analysis. There were 276 patients with typical juvenile polyps (Fig. 2C), 4 patients with Peutz–Jeghers syndrome, 5 patients with juvenile polyposis, 1 patient with hamartomas, 1 patient with familial adenomatous polyposis, and 1 patient with inflammatory polyp.

4. Discussion

Colorectal polyp is the most common type of gastrointestinal polyps in children, with an incidence up to 1% both in preschool and school-aged children.[11,12] Early diagnosis and treatment are important for these children. Standard diagnostic methods for identifying colorectal polyps, such as air-contrast barium enema or colonoscopy, are technically demanding and invasive for children. There may be difficulty in bowel preparation and lack of patient cooperation, and patient faces radiation exposure and

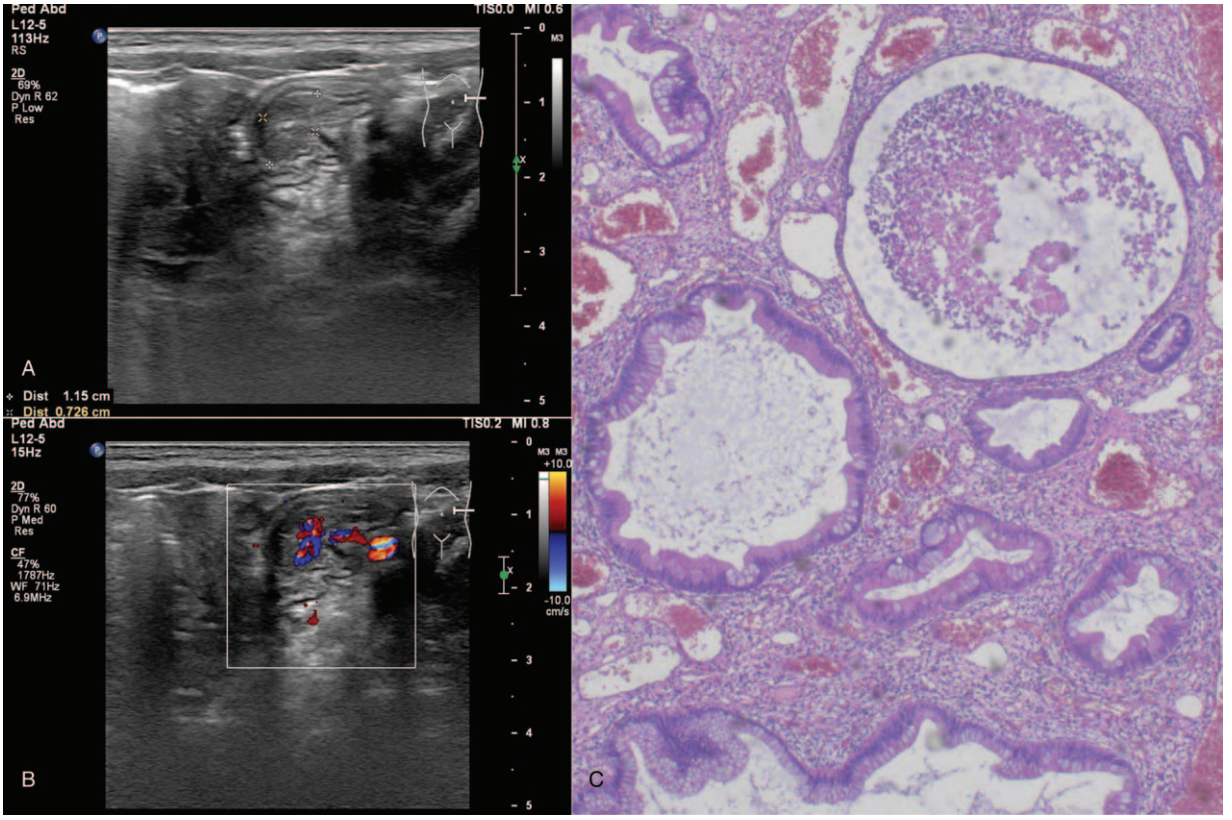

Figure 2. Ultrasonic examination and pathology result of a 6-year-old boy with solitary polyp. A, Ultrasonic examination showed one intraluminal, pedunculated nodule in the left abdomen. B, Color Doppler showed umbrella-shaped abundant blood flow signals within the polyp and pedicle. C, Histological examination of the specimen demonstrated a typical juvenile polyp with a flattened epithelium and large tubular and cystic lakes.

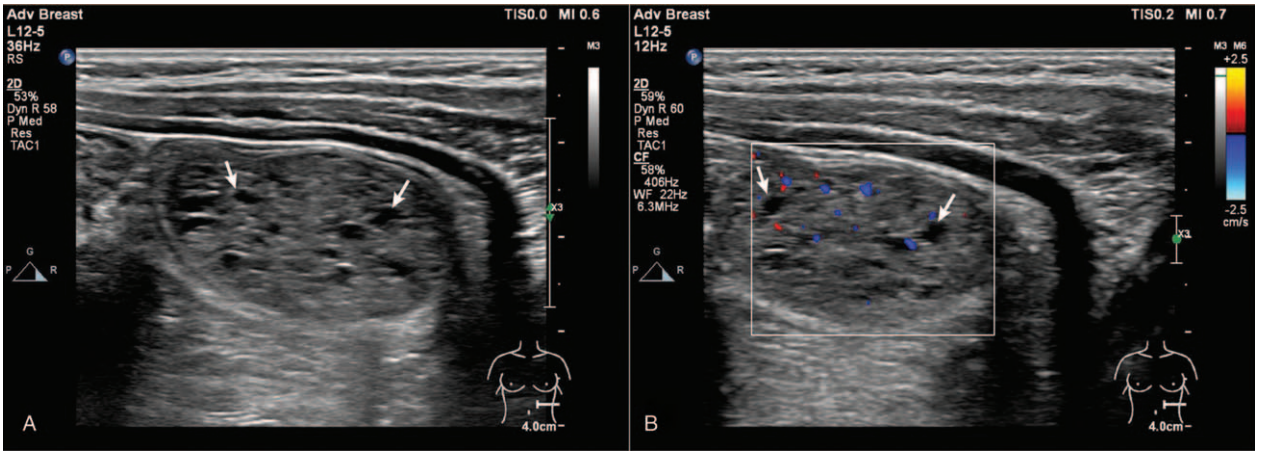

Figure 3. Ultrasonic examination result of a 3-year-old girl with solitary polyp. A, Ultrasonic examination showed intraluminal moderate-echo nodules in the left lower abdomen, with clear edges, associated with inner multiple cystic structures; (B) color Doppler examination showed abundant blood flow signals within polyps and pedicles. Arrows indicated typical cystic structures within the polyp.

possible traumatic rupture of the bowel.[9] What's more, barium enema formerly served as the primary screening method but its detection rate was relatively low (76%).[1] Likewise, colonoscopy has its limitations in detecting small polyps.[13] In addition, incidence of complications after colonoscopy with or without therapeutic intervention was 5% to 1.4%.[1,14] In contrast, ultrasonography is not associated with large amounts of radiation exposure, and it has no incidence of complications. However, this method is seldom used to diagnose colorectal polyps in children before a colonoscopy.[15] In addition, there was no previous report on comparison between the ultrasonic diagnosis of colorectal polyps with and without basic glycerine enema colon preparation of different age group.

In our series, the sensitivity and specificity of ultrasonography with glycerine enema were 94.79% and 100%, which was significantly higher than the 76% identification rate for air contrast barium enema as previously reported.[1] Reports of the necessity of colon preparation before ultrasonic examination to enable the detection of intraluminal lesions were inconsistent. Parra et al[7] reported that the use of the graded compression technique allowed the diagnosis of intestinal polyps with sonography in children without the use of a colon preparation, but a fasting regimen was required for elective sonography. Baldisserotto et al[8] revealed intestinal polyps could be detected by graded compression gray-scale and color doppler sonography without colon preparation. Walter et al[16] described a colonic polyp on sonography in a patient examined after the transrectal instillation of 800 mL of tap water into the colon. The lesion was overlooked with a colonoscopy and barium enema. Skaane et al[15] considered that the ultrasonic demonstration of gastrointestinal polyps required a fluid-filled bowel segment. However, Nagita et al[9] sonographically examined 39 patients suspected of having intestinal polyps after bowel preparation, and 25 patients were found to have colonic polyps. They suggested that bowel preparation aided in the detection of polyps by separating them from the stool. The small sample sizes and lack of consistency in these studies restricted their clinical value. Meanwhile, most children cannot tolerate fasting and colonic injection of water before the examination, especially those under 3 years.

In our study, the ultrasound examination with graded compression maneuvering was initially performed on all patients without colon preparation. For all 278 solitary polyps, 180 polyps were found (64.74%). Our initial examination showed an unclear boundary between the polyp and the intestinal wall because our patient presented with plenty of fecal mass. Furthermore, compressive maneuvers were difficult for some obese patients. We could not detect the pedicle and confirm the relationship between the lesion and the colonic lumen, especially for the polyps in rectum, sigmoid colon and descending colon. After the application of glycerine enema, the pedicle and the relationship between the polyp and the intestinal wall were clearly visible. The proportion of polyps in rectum, sigmoid colon and descending colon all improved obviously. The identification

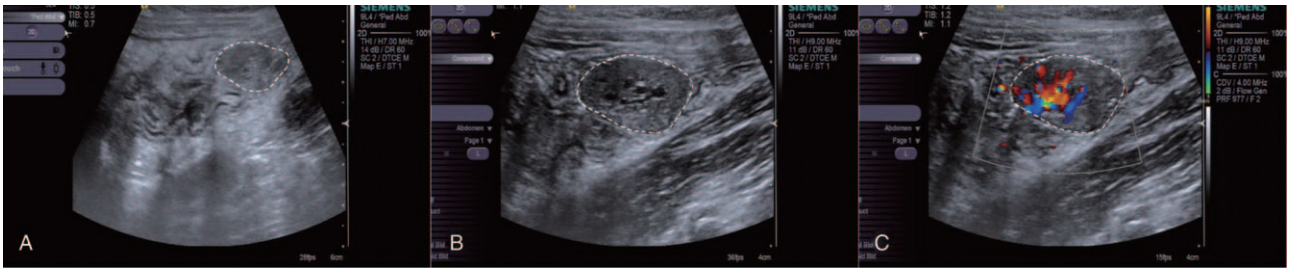

Figure 4. Comparison of the ultrasonic images of a 5-year-old boy with solitary juvenile polyp in the splenic flexure of the colon before and after glycerine enema treatment. A, A pre-enema ultrasound examination revealed abdominal mass; (B) after the glycerine enema treatment, the mass was clearly revealed within the intestinal lumen; (C) color Doppler sonogram showed blood flow in the polyp. Dashed lines showed the position of the polyp.

rate of polyps was significantly higher for the patients with colon preparation than for those without. The sensitivity of ultrasonography with glycerine enema for the detection of colorectal polyps was improved obviously.

In our study, there were 84 cases of polyps diagnosed differently by ultrasonography before and after basic colonic preparation. The ages of patients who had missed diagnosis for polyps in the rectum were mainly > 6 years, for those in the sigmoid colon > 3 years and for polyps in the descending colon, transverse colon and ascending colon there was no missed diagnosis in the age group of < 3 years. This finding suggested that for patients under 3 years the diagnosis rate of ultrasonography by pressing the gastrointestine was satisfactory. For patients above 3 years, basic colon preparation could significantly increase the diagnosis rate for polyps, especially when the polyps were highly suspected in the descending colon, sigmoid colon, and rectal segment. This finding is instructive for clinical doctors in choosing the appropriate ultrasonography method according to the patient's age and symptom.

Basic colon preparation in this study has the following advantages: firstly, it was first large-scale cohort study comparing the diagnostic accuracy before and after basic colon preparation for colorectal polyp in children. Secondly, it indicated the necessity of basic colon preparation before ultrasonic testing to enable the detection of intraluminal lesions for children who pass red bloody stools either with or without abdominal pain. This enabled the clinical team to perform the polypectomy via a colonoscopy more purposely, which reduced the false-positive rate of colonoscopy, avoided the need for surgery and minimized the risk of complications. Thirdly, comparing to the traditional colon preparation of fasting or anal injection of water, our basic glycerine enema protocol was less painful and was more pleasant to be accepted by children, especially those suspected with low colon polyp after 3 years, while for patients under 3 years the diagnosis rate of ultrasonography by pressing the gastrointestine was satisfactory.

It is worth mentioning that ultrasonography for colonic polyps have its limitations. Many factors can affect the sonographic detection of colorectal polyps despite their typical appearance on ultrasound. Difference in the examiners' technical skills, concealed by gas and/or stool, and their deep location in the abdomen or pelvis might all account for the misdiagnosis of those polyps.[7,8,17] To overcome these limitations, the following procedures were adopted in our study: each sonographic examination was performed by 2 sonographers according to a standard protocol, and images were saved for later review in order to minimize the chance of missed diagnosis due to technical reasons or nonstandard operations; high- and low-frequency probes were used in combination to reduce the misdiagnosis of polyps located deep in the pelvic cavity and abdominal cavity; transabdominal and transrectal sonographic examinations were combined to reduce the misdiagnosis of polyps at the end of the colon. Basic colon preparation before an ultrasonic examination is necessity for children who pass red bloody stools either with or without abdominal pain. The utilization of the above factors combination significantly increased the diagnostic accuracy for colorectal polyps comparing to previous report.[9] This further demonstrated that ultrasonography can be used as a primary noninvasive diagnosis method for colorectal polyps in children.

Kay et al[18] reported that genetic testing was key in the identification, screening, and follow-up of children and adolescents with polyposis syndromes. Hood et al[19] studied the clinical features and colonoscopic findings in children with solitary juvenile polyps, multiple juvenile polyps, and juvenile polyposis syndrome. This was the first large-scale cohort study discussing the diagnosis of multiple polyps by ultrasonography. Ultrasonography could preliminary indicate the presence of multiple polyps. However, it is limited in identifying the accurate number of polyps, especially the diffuse polyps. Ultrasonography could identify multiple polyps and facilitate further surgical or colonoscopic treatment. In the meantime there were some limitations in estimating accurately the number and location of multiple polyps.

5. Conclusions

Ultrasonography can be the primary diagnostic method for screening colorectal polyps in children due to its safety, validity and accuracy. Basic colon preparation with glycerine enema is recommended for children, which enable the detection of intraluminal lesions before ultrasonic examination.

Author contributions

Conceptualization: Jie Li.
Data curation: Rui-hua Liu.
Formal analysis: Rui-hua Liu.
Methodology: Ni-na Qu, Xiao-li Cao, Jie Li.
Project administration: Rui-hua Liu, Lei Shi, Yong-jun Yang.
Resources: Lei Shi.
Software: Yong-jun Yang.
Supervision: Lei Shi, Yong-jun Yang, Jie Li.
Visualization: Xiao-li Cao.
Writing – original draft: Ni-na Qu.
Writing – review & editing: Xiao-li Cao, Jie Li.

References

[1] Pillai RB, Tolia V. Colonic polyps in children: frequently multiple and recurrent. Clin Pediatr 1998;37:253–7.
[2] Wei C, Dayong W, Liqun J, et al. Colorectal polyps in children: a retrospective study of clinical features and the value of ultrasonography in their diagnosis. J Pediat Surg 2012;47:1853–8.
[3] Baek MD, Jackson CS, Lunn J, et al. Endocuff assisted colonoscopy significantly increases sessile serrated adenoma detection in veterans. J Gastrointest Oncol 2017;8:636–42.
[4] Mandhan P. Juvenile colorectal polyps in children: experience in Pakistan. Pediatr Surg Int 2004;20:339–42.
[5] Rosman AS, Korsten MA. Meta-analysis comparing CT colonography, air contrast barium enema, and colonoscopy. Am J Med 2007;120:203–10.
[6] Zhang Y, Li SX, Xie LM, et al. Sonographic diagnosis of juvenile polyps in children. Ultrasound Med Biol 2012;38:1529–33.
[7] Parra DA, Navarro OM. Sonographic diagnosis of intestinal polyps in children. Pediat Radiol 2008;38:680–4.
[8] Baldisserotto M, Spolidoro JV, Bahu Mda G. Graded compression sonography of the colon in the diagnosis of polyps in pediatric patients. AJR Am J Roentgenol 2002;179:201–5.
[9] Nagita A, Amemoto K, Yoden A, et al. Ultrasonographic diagnosis of juvenile colonic polyps. J Pediatr 1994;124:535–40.
[10] Jelsig AM, Ousager LB, Brusgaard K, et al. Juvenile polyps in Denmark from 1995 to 2014. Dis Colon Rectum 2016;59:751–7.
[11] Erdman SH, Barnard JA. Gastrointestinal polyps and polyposis syndromes in children. Curr Opin Pediat 2002;14:576–82.
[12] Kennedy RLJ. Polyps of rectum and colon in infants and in children. Am J Dis Child 1941;62:481–8.
[13] van Rijn JC, Reitsma JB, Stoker J, et al. Polyp miss rate determined by tandem colonoscopy: a systematic review. Am J Gastroenterol 2006;101:343–50.
[14] Lee J, Park SW, Kim YS, et al. Risk factors of missed colorectal lesions after colonoscopy. Medicine 2017;96:e7468.
[15] Skaane P. Ultrasonic demonstration of a pedunculated colonic polyp. J Clin Ultrasound 1987;15:204–6.

[16] Walter DF, Govil S, Korula A, et al. Pedunculated colonic polyp diagnosed by colonic sonography. Pediatr Radiol 1992;22:148–9.
[17] Gupta SK, Fitzgerald JF, Croffie JM, et al. Experience with juvenile polyps in North American children: the need for pancolonoscopy. Am J Gastroenterol 2001;96:1695–7.
[18] Kay M, Eng K, Wyllie R. Colonic polyps and polyposis syndromes in pediatric patients. Curr Opin Pediatr 2015;27:634–41.
[19] Hood B, Bigler S, Bishop P, et al. Juvenile polyps and juvenile polyp syndromes in children: a clinical and endoscopic survey. Clin Pediat 2011;50:910–5.