
Diagnostic application of transabdominal ultrasound in pediatric patients with hematochezia.

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Key words: transabdominal ultrasound; hematochezia; diagnosis.

Abstract. The objective of the work was to analyze the diagnostic accuracy of transabdominal ultrasound in diseases causing hematochezia. The present retrospective study included 427 pediatric patients with hematochezia or hematochezia accompanied by abdominal pain, who came to our hospital from October 2014 to September 2018. Transabdominal ultrasound was performed in all patients. Demographic data such as age, gender and clinical variables including symptoms and the hematochezia aspect were recorded. The diagnostic accuracy was analyzed. Among all patients, the hematochezia types were dark red bloody stools 163 (38.2%), black stools 102 (23.9%), jam-like bloody stools 74 (17.3%), scarlet blood 55 (12.9%) and fecal occult blood 33 (7.7%). There were 153 (35.8%) patients with intussusception, 116 (27.2%) patients with Meckel's diverticulum, 95 (22.2%) patients with intestinal duplication, and 63 (14.8%) patients with intestinal polyps. Transabdominal ultrasound showed there were 150 patients with intussusception, with an accuracy of 98.0%; 103 patients with Meckel's diverticulum, with an accuracy of 88.8%; 84 patients with intestinal duplication, with an accuracy of 88.4%; and 54 patients with intestinal polyps, with an accuracy of 85.7%. The diagnostic sensitivity was significantly higher for intussusception than for other diseases. It is concluded that transabdominal ultrasound had a high accuracy in the diagnosis of hematochezia-related diseases, including intussusception, Meckel's diverticulum, intestinal polyps and intestinal duplication.

Aplicación diagnóstica del ultrasonido transabdominal en pacientes pediátricos con hematoquecia.

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Palabras clave: ultrasonido transabdominal; hematoquecia; diagnóstico.

Resumen. El objetivo del presente trabajo fue analizar la precisión diagnóstica de la ecografía transabdominal en enfermedades relacionadas con hematoquecia. El presente estudio retrospectivo incluyó un total de 427 pacientes pediátricos con hematoquecia o hematoquecia acompañada de dolor abdominal, que acudieron a nuestro hospital entre octubre de 2014 y septiembre de 2018. Se realizó una ecografía transabdominal en todos los pacientes. Se registraron datos demográficos como la edad, el sexo y las variables clínicas, incluidos los síntomas y el aspecto de la hematoquecia. Se analizó la precisión diagnóstica. Entre todos los pacientes, los tipos de hematoquecia presentes fueron: heces con sangre de color rojo oscuro 163 (38.2%), heces negras 102 (23.9%), heces con sangre como mermelada 74 (17.3%), sangre escarlata 55 (12.9%) y sangre oculta en heces 33 (7,7%). Hubo 153 (35,8%) pacientes con invaginación intestinal, 116 (27,2%) pacientes con divertículo de Meckel, 95 (22,2%) pacientes con duplicación intestinal y 63 (14,8%) pacientes con pólipos intestinales. La ecografía transabdominal mostró que había 150 pacientes con invaginación intestinal, con una precisión del 98,0%; 103 pacientes con divertículo de Meckel, con una precisión del 88,8%; 84 pacientes con duplicación intestinal, con una precisión del 88,4%; y 54 pacientes con pólipos intestinales, con una precisión del 85,7%. La sensibilidad diagnóstica fue significativamente mayor para la invaginación intestinal que para otras enfermedades. Se concluye que la ecografía transabdominal tuvo una alta precisión en el diagnóstico de enfermedades relacionadas con la hematoquecia, incluidos la invaginación intestinal, el divertículo de Meckel, los pólipos intestinales y la duplicación intestinal.

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INTRODUCTION

Hematochezia, also known as acute overt lower gastrointestinal bleeding, accounts for about 20% of all gastrointestinal bleeding (1-3). Since many diseases may lead to hematochezia, patients with hematochezia often need hospital admission and may receive various clinical detections, such as endoscopic, radiographic detection or nuclear medicine (4-6). Though most hematochezia patients will stop bleeding and recover, some patients without timely treatment will prog-

ress to more serious consequences, especially for children and elderly patients (7, 8).

For pediatric patients, an intestinal malformation is one of the main causes of hematochezia (9, 10). The most common diagnosis method for hematochezia is the colonoscopy (11, 12). Despite the advantages of colonoscopy, which can provide accurate diagnosis and endotherapy, it is not convenient for the diagnosis in pediatric patients. Trans-abdominal ultrasound, a widely used method in diagnosis of many diseases, is reported to be sufficient in the diagno-

sis of intestinal diseases (13, 14). However, the diagnostic accuracy of trans-abdominal ultrasound for patients with hematochezia symptoms is still to be determined.

In the present retrospective study, we aimed to analyze the diagnostic accuracy of trans-abdominal ultrasound in pediatric patients with hematochezia. This study might give additional evidences for the application of trans-abdominal ultrasound in the diagnosis of hematochezia-related diseases.

PATIENTS AND METHODS

The present retrospective study included 916 pediatric patients with hematochezia or hematochezia accompanied with abdominal pain who came to our hospital from October 2014 to September 2018.

The inclusion criteria in the study were: (1) hospitalized children <14 years old; (2) hematochezia was the main clinical manifestation. Exclusion criteria: (1) false fecal blood of non-gastrointestinal bleeding: a. hematochezia caused by swallowing blood: such as mother's ruptured nipple bleeding, swallowed by the child when sucking milk; b. swallowing blood when bleeding occurs in the nasal cavity, mouth or gums; c. feed on animal blood such as chicken blood, pig blood or liver (2) black stools that appeared after taking some drugs, such as iron, Chinese medicines, etc. (3) patients that had severe heart, renal, liver diseases, infection or hematological diseases (4) patients that had an incomplete medical history.

Among the children, 427 patients were finally selected. This study was approved by the Ethic Committee of Children's Hospital of Anhui Medical University Hospital. Demographic data such as age, gender and clinical variables including symptoms and the hematochezia aspect were recorded.

For ultrasonic detection, the Siemens ACUSON S2000 (Siemens Healthcare, Erlangen, Germany), MINDRAY DC-8 (MINDRAY, China) and Philips HD15 (Philips Medizin Systeme, Hamburg, Germany) color ultrason-

ic imagers were used, with a frequency 5~12 MHz. Other parameters were default setting and changed according to different patients. Briefly, patients were placed in a supine position; for uncooperative patients, 10% chloral hydrate (0.5 mL/kg) was used before the detection. The probe was used to detect all trans-abdominal places. The detection depth, scanning gain and focusing area were altered to get the best photograph. When too much intestinal gas existed, the patients' position was changed or the detection place was properly pressed. The patients were asked to drink water or juice 20~30 min before detection to stimulate the intestinal peristalsis if necessary. For obese patients or patients with polyps in the sigmoid colon or in the rectum, an enema was administered using the proper amount of warm normal saline. All data and pictures were recorded. All detection results were further confirmed by enteroscopy or colonoscopy and pathological analysis.

Statistical analysis

The measurement data was expressed by mean \pm SD. The Chi square test was used for comparison of counting materials. It was considered to be statistically significant when P-value was less than 0.05. All calculations were made using SPSS 18.0.

RESULTS

Basic characteristics for all patients

The present study included a total of 427 children patients with hematochezia, with a mean age 4.7 ± 2.3 years (3~13), male:female 231:196. As shown in Table I, among all patients, the hematochezia types were dark red bloody stools in 163 (38.2%), black stools in 102 (23.9%), jam like bloody stools in 74 (17.3%), scarlet blood in 55 (12.9%) and fecal occult blood in 33 (7.7%). Besides, 215 (50.4%) patients showed intestinal colic accompanied with hematochezia, 128 (29.9%) patients showed abdominal distention accompanied with hematochezia, and 84 (19.7%) patients only showed simple hematochezia.

TABLE I
BASIC CHARACTERISTICS OF ALL PATIENTS.

Variables	Value
Age, years	4.7±2.3
Gender, male: female	231: 196
Symptom	n (%)
Intestinal colic accompanied with hematochezia	215 (50.4)
Abdominal distention accompanied with hematochezia	128 (29.9)
Simple hematochezia	84 (19.7)
Hematochezia type	n (%)
Dark red bloody stool	163 (38.2)
Black stool	102 (23.9)
Jam like bloody stool	74 (17.3)
Scarlet blood	55 (12.9)
Fecal occult blood	33 (7.7)

Pathological results for all patients

The pathogeny of hematochezia was confirmed by pathological analysis for all patients. Among all patients, there were 153 (35.8%) with intussusception, 116 (27.2%) with Meckel's diverticulum, 95 (22.2%) with intestinal duplication and 63 (14.8%) with intestinal polyps (Table II).

The diagnostic accuracy of trans-abdominal ultrasound for all patients

At last, we analyzed the diagnostic accuracy of trans-abdominal ultrasound for all patients. Among all patients, trans-abdominal ultrasound showed there were 150 patients with intussusception, with an accuracy of 98.0%; 103 patients with Meckel's diverticulum, with an accuracy of 88.8%; 84 patients with intestinal duplication, with an accuracy of 88.4%; and 54 patients with intestinal polyps, with an accuracy of 85.7%. The diagnostic sensitivity was significantly higher in different diseases (Table III).

The typical ultrasound pictures for the above patients are shown in Fig. 1. For intussusception, the sonogram showed that there was a low echo mass with clear boundaries, regular margin and different sizes in the abdominal cavity. The diameter of small intes-

tine type was about 2 cm, and the diameter of colon type was ≥ 3 cm. Its cross section showed "target ring" sign, "false kidney" sign or "sleeve" sign. For Meckel's diverticulum, all imaging showed that there was an abnormal shape of an intestinal loop in the abdominal cavity, and the wall thickness was about 0.4-1.0 cm, and there was no obvious peristalsis. For intestinal duplication, we can always observe a spherical, tubular, or diverticulate cavity mass attached to the mesenteric side of the intestine and communicating with the intestine. The ultrasonic features of the cyst are that the wall of the cyst is thick, like the echo of the normal intestinal wall; it has the characteristics of mucosa layer, muscular layer and serosa layer, showing "strong weak strong" stratification. CDFI can show the blood flow signal of the cyst wall. For intestinal polyps, the sonograms showed round or oval solid mass with low or medium echo, clear boundary, heterogeneous internal echo, scattered round like liquid dark area, polyp connected with intestinal wall through different pedicle. These results indicated that the trans-abdominal ultrasound had high accuracy for the diagnosis of hematochezia related diseases.

TABLE II
PATHOLOGICAL RESULTS FOR ALL PATIENTS.

Variables, n (%)	Intussusception	Meckel's diverticulum	Intestinal duplication	Intestinal polyps	Total
Dark red bloody stool	112	8	40	3	163 (38.2)
Black stool	4	63	33	2	102 (23.9)
Jam like bloody stool	31	29	12	2	74 (17.3)
Scarlet blood	3	10	5	37	55 (12.9)
Fecal occult blood	3	6	5	19	33 (7.7)
Total	153 (35.8)	116 (27.2)	95 (22.2)	63 (14.8)	

TABLE III
THE DIAGNOSTIC ACCURACY OF TRANS-ABDOMINAL ULTRASOUND FOR ALL PATIENTS.

Variables, n (%)	Intussusception, n=153	Meckel's diverticulum, n=116	Intestinal duplication, n=95	Intestinal polyps, n=63
Diagnosed	150 (98.0)	103 (88.8)	84 (88.4)	54 (85.7)
Missed diagnosis	3 (2.0)	10 (8.6)	8 (8.4)	7 (11.1)
Misdiagnosis	0 (0)	3 (2.6)	3 (3.2)	2 (3.2)
Diagnostic rate	98.0%	88.8%	88.4%	85.7

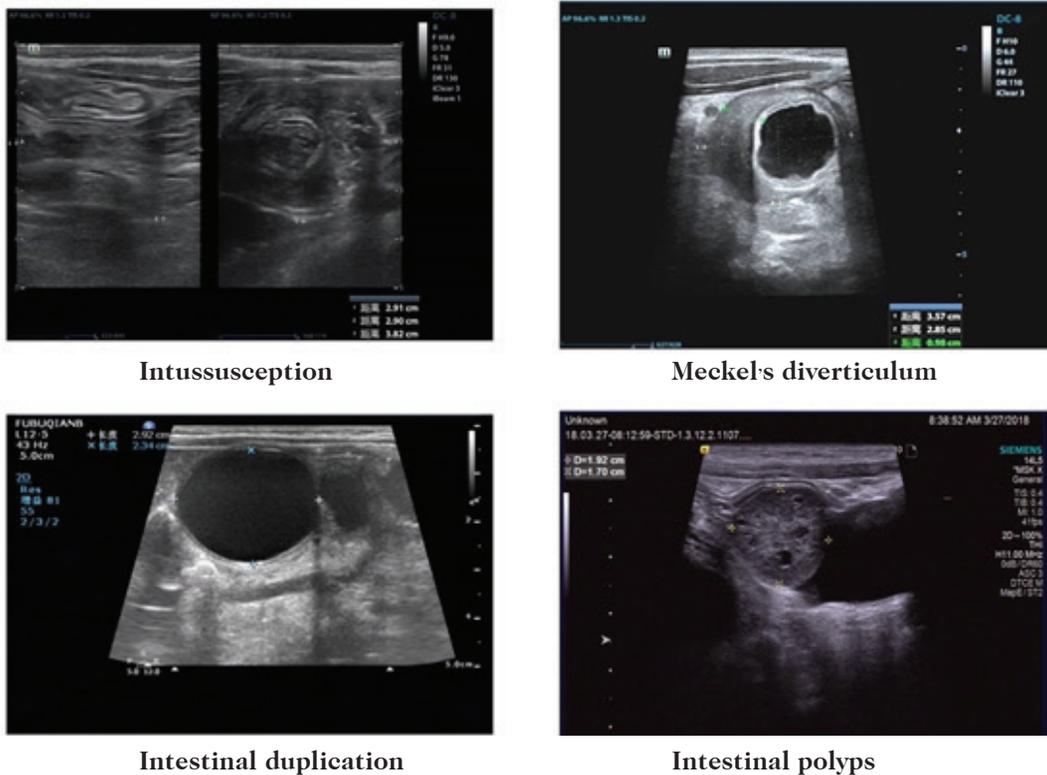


Fig. 1. Typical ultrasound pictures for intussusception, Meckel's diverticulum, intestinal duplication and intestinal polyps.

DISCUSSION

The diagnostic application of trans-abdominal ultrasound has been widely adopted in many diseases. However, the diagnostic accuracy of trans-abdominal ultrasound for patients with hematochezia is seldom analyzed. In the present retrospective study, we confirmed for the first time that trans-abdominal ultrasound had a high accuracy in the diagnosis of hematochezia-related diseases, including intussusception, Meckel's diverticulum, intestinal polyps and intestinal duplication.

The diagnosis of hematochezia has been reported in many researches. Nava-neethan et al showed that colonoscopy was sufficient in the diagnosis of hematochezia and early diagnosis might reduce the length of the hospital stay and hospitalization costs in patients with lower gastrointestinal bleeding (12). Epifanio et al demonstrated color Doppler ultrasound was accurate in the diagnosis of allergy induced hematochezia (15). Recently, it was also found that a multi-detector row helical CT was useful in the diagnosis of acute massive gastrointestinal bleeding (16). However, despite these researches, more clinical evidences are still needed for trans-abdominal ultrasound in the diagnosis of hematochezia.

The diagnostic value of ultrasound was also reported in lower gastrointestinal bleeding and other gastrointestinal diseases. Yamaguchi *et al* showed trans-abdominal ultrasound was useful in the diagnosis of lower gastrointestinal bleeding; however most of the cases that the study included were colitis and cancer (17). In a recent study, a sonographic method was also found to be effective in the diagnosis of an ileal adenomyoma in a neonate (18). Multiparametric ultrasound could be used in the diagnosis and monitoring of ischemic colitis (19). Ultrasound was also reported to be useful in the diagnosis of intussusception (20), intestinal duplication (21), Meckel's diverticulum (22) and intestinal polyps (23). However, despite

the researches, studies focusing on the diagnosis and differentiation of hematochezia-related diseases by trans-abdominal ultrasound are still few. In the present research, we found trans-abdominal ultrasound was also valuable and accurate in the diagnosis of diseases, which induced hematochezia. The present study also has some limitations, such as the limited size of the study samples.

In conclusion, we conducted a retrospective study to analyze the diagnostic accuracy of trans-abdominal ultrasound in the detection of hematochezia-related diseases in pediatric patients. The results show that the trans-abdominal ultrasound had a high accuracy in the diagnosis of hematochezia related diseases, including intussusception, Meckel's diverticulum, intestinal polyps and intestinal duplication. This study might give additional clinical evidences for the application of trans-abdominal ultrasound in the diagnosis of hematochezia.

REFERENCES

1. **Gralnek IA, Holub JL, Eisen GM.** The role of colonoscopy in evaluating hematochezia: a population-based study in a large consortium of endoscopy practices. *Gastrointest Endosc* 2013;77(3):410-418.
2. **Segal WN, Greenberg PD, Rockey DC, Cello JP, Mcquaid KR.** The outpatient evaluation of hematochezia. *Am J Gastroenterol* 1998;93(2):179-182.
3. **Vitor S, Oliveira FA, Lopes J, Velosa J.** Hemangioma of the rectum - How misleading can hematochezia be? *Rev Esp Enferm Dig* 2016;108(8):500-501.
4. **Kanwal F, Dulai G, Jensen DM, Gralnek IM, Kovacs TO, Machicado GA, Jutabha R.** Major stigmata of recent hemorrhage on rectal ulcers in patients with severe hematochezia: Endoscopic diagnosis, treatment, and outcomes. *Gastrointest Endosc* 2003;57(4):462-468.
5. **Jensen DM.** Diagnosis and treatment of patients with severe hematochezia: a time for change. *Endoscopy* 2008;30(08):724-726.
6. **Jensen DM, Kovacs TO, Jutabha R, Ohning GV, Dulai GS, Machicado GA.** Rectal ulcers

- causing severe hematochezia: update on diagnosis, hemostasis, healing & outcomes. *Gastrointest Endosc* 2007;65(5):AB258.
7. **Arroja B, Cremers I, Ramos R, Cardoso C, Rego AC, Caldeira A, Eliseu L, Silva JD, Glória L, Rosa I.** Acute lower gastrointestinal bleeding management in Portugal: a multicentric prospective 1-year survey. *Eur J Gastroenterol Hepatol* 2011;23(4):317-322.
 8. **Ruddy TW, Saclarides TJ.** Lower Gastrointestinal Bleeding. *Surg Clin North Am* 2014;94(1):55-63.
 9. **Borsellino A, Poggiani C, Alberti D, Cheli M, Bernardi M, Locatelli C, Locatelli G.** Lower gastrointestinal bleeding in a newborn caused by isolated intestinal vascular malformation. *Pediatr Radiol* 2003;33(1):41-43.
 10. **Balachandran B, Singhi S.** Emergency management of lower gastrointestinal bleed in children. *Indian J Pediatr* 2013;80(3):219-225.
 11. **Elta GH.** Urgent colonoscopy for acute lower-GI bleeding. *Gastrointest Endosc* 2004;59(3):402-408.
 12. **Navaneethan U, Njei B, Venkatesh PG, Sanaka MR.** Timing of colonoscopy and outcomes in patients with lower GI bleeding: a nationwide population-based study. *Gastrointest Endosc* 2014;79(2):297-306.
 13. **Rodgers PM, Verma R.** Transabdominal ultrasound for bowel evaluation. *Radiol Clin North Am* 2013;51(1):133-148.
 14. **Tanomkiat W, Chongchitnan P.** Transabdominal sonography of gastroesophageal junctions. *J Clin Ultrasound* 2015;27(9):505-512.
 15. **Epifanio M, Spolidoro JV, Missima NG, Soder RB, Garcia PCR, Baldisserotto M.** Cow's milk allergy: color Doppler ultrasound findings in infants with hematochezia. *J Pediatr (Rio J)* 2013;89(6):554-558.
 16. **W Y, YY J, SS S, HS L, SG S, NG J, JK K, HK K.** Acute massive gastrointestinal bleeding: detection and localization with arterial phase multi-detector row helical CT. *Radiology*. 2014;239(1):160-167.
 17. **Yamaguchi T, Manabe N, Hata J, Tanaka S, Haruma K, Chayama K.** The usefulness of transabdominal ultrasound for the diagnosis of lower gastrointestinal bleeding. *Aliment Pharmacol Ther* 2010;23(8):1267-1272.
 18. **Yan Y, Liu Q, Liu X, Zhang X, Miao L, Pang H, Zhang A.** Sonographic diagnosis of an ileal adenomyoma in a neonate. *J Clin Ultrasound* 2019;47(2):97-99.
 19. **Giannetti A, Matergi M, Biscontri M, Tedone F, Falconi L, Giovannelli L, Ussia V, Franci L, Pieraccini M.** Multiparametric ultrasound in the diagnosis and monitoring of ischemic colitis: description of a case of ischemic colitis of the right colon and revision of the literature. *J Ultrasound*. 2019;22(4):477-484.
 20. **Gingrich AS, Saul T, Lewiss RE.** Point-of-care ultrasound in a resource-limited setting: diagnosing intussusception. *J Emerg Med* 2013;45(3):E67-E70.
 21. **Herranz Barbero A, Prat Ortells J, Muñoz Fernández ME, Castañón García-Alix M, Figueras Aloy J.** Intestinal cystic duplication. Case report. *Arch Argent Pediatr* 2017;115(4):e233-e236.
 22. **Pepper VK, Stanfill AB, Pearl RH.** Diagnosis and management of pediatric appendicitis, intussusception, and Meckel diverticulum. *Surg Clin North Am* 2012;92(3):505-526.
 23. **Bamakhrama K, Abdulhady L, Vilmann P.** Endoscopic ultrasound diagnosis of pneumatosis cystoides coli initially misdiagnosed as colonic polyps. *Endoscopy* 2014;46(S 01):E195-E196.