International Journal of Advances in Medicine
Shiekh Y et al. Int J Adv Med. 2019 Oct;6(5):1567-1573
http://www.ijmedicine.com
pISSN 2349-3925 | eISSN 2349-3933
DOI: http://dx.doi.org/10.18203/2349-3933.ijam20194220

Original Research Article

Ultrasound guided hydrostatic reduction of intussusception: suitability and effectiveness with factors affecting its successful outcome

Yassar Shiekh, Aamir Javed Khan, Shafqat Shabir Bhawani*

Department of Radiodiagnosis, Government Medical College Srinagar, Jammu and Kashmir, India

Received: 27 July 2019
Accepted: 18 September 2019

***Correspondence:**
Dr. Shafqat Shabir Bhawani,
E-mail: dr.shafqatshabir@gmail.com

ABSTRACT

Background: Intussusception being the leading cause of acute abdomen in childhood, its timely and accurate diagnosis assumes utmost significance in reducing the morbidity and mortality. Childhood intussusceptions are still managed surgically in our region; however, non-operative reduction has now become the gold standard of treatment worldwide. In this study, authors desired to evaluate the suitability and effectiveness of hydrostatic reduction of intussusception under ultrasound (USG)-guidance and to scrutinize the factors affecting the successful outcome.
Methods: Ours was a prospective study carried out at a tertiary care centre in central Kashmir. All except those with clinical features of bowel gangrene, intestinal prolapse and peritonitis underwent ultrasound-guided hydrostatic reduction (USGHR). A maximum of three attempts were allowed.
Results: Mean age of the patients was 11.2±8.8 months with age range of 3-50 months. 69.1% (n=38) of the patients presented within 24 h of being symptomatic while 30.9% had delayed presentation (>24 h). The success rate of USGHR was 81.8% (n=45). Late presentation, age and gender of the patients had no influence on successful outcome of the procedure, p >0.005. The duration of hospital stay between those who had successful hydrostatic reduction and those who afterwards underwent operative reduction or resection achieved statistical significance, p=0.0015. Authors attained a 66.2 % (45/68) reduction in operative management using USGHR as the main modality of treatment.
Conclusions: USGHR is a simple, safe and effective non-operative method of treating intussusceptions in children in a limited resource setting.

Keywords: Hydrostatic reduction, Intussusception, Saline, Ultrasound-guided

INTRODUCTION

Intussusception refers to the telescoping of a proximal segment of intestine (intussusceptum) into a more distal segment (intussuscipiens), and is the commonest cause of intestinal obstruction in infants and toddlers, aged between 3-24 months, requiring prompt radiologic or surgical intervention in acute presentation.[1,2] Majority of the patients present with symptoms of obstruction (abdominal pain, vomiting) along with bleeding per rectum and a palpable mass in the right half of the abdomen.[3] The diagnosis is often made on the basis of clinical findings, supplemented by radiological studies, amongst which ultrasonography (USG) is the modality of choice with a sensitivity and specificity approaching 100% in the experienced hands.[3] Albeit intussusceptions ware earlier treated by surgical methods, presently non-operative methods of reduction like pneumatic or hydrostatic enema reduction under fluoroscopic or USG guidance are preferred. Nevertheless, late patient presentation in our setting coupled with misdiagnosis from peripheral health facilities owing to lack of modern

imaging equipment and lack of expertise preclude non-operative reduction methods, thus making surgery imperative.[4,5] First described by Kim et al. in 1982, Ultrasound guided hydrostatic reduction has now become a well-known surrogate method for reduction of intussusception in children owing to lesser morbidity and mortality in comparison to surgical form of treatment.[6-8] Besides hydrostatic reduction, other forms of non-operative methods include barium enema or pneumatic reduction under fluoroscopic guidance.[7,9] These additional non-operative methods of reduction under fluoroscopic guidance are either defunct or extinct in most centres in North India inclusive of our hospital, by that constituting ultrasound guided reduction of intussusception, a preferred treatment modality in limited resource setting. Besides being cost-effective and widely available, the main advantage of ultrasound as a guidance modality is the lack of ionizing radiation, which is a major concern in young children.[4,10]

Being the first-line imaging modality for the diagnosis of intussusception, ultrasound guided hydrostatic reduction can be performed in the same sitting once the diagnosis is made.[7,9] Other ancillary benefits of ultrasound guided hydrostatic reduction in comparison to operative modality of treatment are lesser patient discomfort, shorter hospital stay and less morbidity and mortality. For ultrasound guided liquid enema, the varied enemas in use are portable tap water, normal saline or Ringers lactate solution.[9,11,12]

Bekdash et al, in a review study quoted the overall success rate of non-operative methods of intussusception reduction as ranging from 46 to 94%. Few other recent studies report the success rate for hydrostatic reduction of intussusceptions with saline ranging from 55.6 to 90%.[4,13-15] A much more recent study conducted in Ethiopia in 2018 found a success rate of hydrostatic reduction to be 87.2%.[10] Authors undertook this study to evaluate the efficacy of ultrasound guided hydrostatic reduction of intussusceptions using normal saline in children regardless of their age and duration of symptoms, as long as they fulfil the inclusion criteria laid down for non-operative reduction of intussusception at our centre.

METHODS

Ours was a prospective cross sectional study conducted between January 2018 to June 2019 with approval from the Institutional Ethical Committee. Prior to each procedure, the risks and benefits of USGHR were discussed with the attendants of the patient and informed consent taken.

Our institution is a tertiary care centre located in central Kashmir, India where it imparts primary and secondary health care services to people in addition to its elementary tertiary care. The people are mainly Kashmiris with the vast majority being artisans, civil servants and farmers. The radiology and paediatric surgical units of our hospital are well-established and equipped with state of the art machinery.

Subjects and inclusion/exclusion criteria

Our study was approved by the Institutional Ethical Committee of the hospital. All consecutive patients with suspected intussusceptions admitted via the paediatric emergency unit of our hospital were enrolled into the study. Prior to each procedure, the risks and benefits of USGHR were discussed with the attendants of the patient and informed consent taken. All cases with ultrasound-documented intussusceptions were included in the study. Children with (1) signs and symptoms of perforation and peritonitis (2) prolapsed intussusceptions were excluded from the study. Data collected from the case files included age, gender, clinical features, duration of symptoms, outcome of treatment, surgical and histo-pathological findings if USGHR failed and patients underwent subsequent laparotomy, complications, and follow-up after discharge. Besides, blood samples for packed cell volume, electrolytes and cross matching were collected from the patient. Other variables recorded were the time elapsed to perform the procedure (USGHR), number of times the procedure was performed, the volume of fluid used in the procedure, in addition to hospital stay.

The outcome measures were successful hydrostatic reduction, failed hydrostatic reduction with consequent surgical intervention, perforation during reduction and recurrence of intussusception after successful reduction. Successful reduction was defined as one with total disappearance of the intussusceptum with passage of saline into the ileum. Authors defined failed reduction as one in which the intussusceptum could not be reduced in entirety or the procedure was complicated by perforation, and thus had to be abandoned midway. Patients presenting after 24 h of abdominal pain were considered as late presentations.

Procedure

IV line was secured in all patients and intravenous infusion of 4.3 Dextrose in N/5 saline was started in order to maintain hydration. Besides, patients were kept nil per os, placed on intravenous metronidazole and cefuroxime and urinary catheter to meet the eventuality of surgery, lest the non-operative reduction failed.

Ultrasound scan of the patient was performed in the radiology department by the radiology senior resident with GE Logic S8 Ultrasound Machine using 10-15 MHz linear high frequency probe to validate or refute the diagnosis of intussusception. After ultrasonographic validation, the attending radiologist in collaboration with senior resident of paediatric surgery performed USGHR. The surgical team comprising of the on-call paediatric surgeon, anaesthetist and peri-operative nurses were

informed antecedent to the procedure to meet the eventuality of complications such as perforation and failed reduction that necessitate surgery.

The patient was kept in the supine position and a suitable sized Foley catheter (10F-18F) was introduced into the rectum followed by balloon inflation. The catheter size was chosen in accordance with the body size of the patient- 10F for infants, 14F for children aged 1-2 years and 16-18F for children older than 3 years. The catheter bulb was inflated with 20-25 cc of normal saline (4-5 times its size) and then pulled back to the entrance of the anal canal to avert peri-catheter fluid leakage. It was then followed by bridging the gap between the two buttocks with the help of a band aid. No sedation or premedication was administered to the patient, who was held back by the staff on duty.

Pre-warmed normal saline (warmed to body temperature, 36.5 - 37.5°C) was introduced via catheter into the rectum and proximal colon by hanging the bottle 120 cms above table height and allowing free flow under gravity.[16] During the procedure, the retrograde movement of saline and the regress of intussusceptum were continuously monitored under real time ultrasound guidance. Besides, the peritoneal cavity was scanned intermittently in order to detect sudden increase in fluid and simultaneous depletion of fluid from the colon, suggesting bowel perforation. A maximum of 3 attempts were permitted, each attempt lasting 3 to 5 min with a gap of less than 3 min between the attempts. After failed third attempt, the procedure was ended without delay and the patient shifted urgently to the operation theatre for surgical reduction or resection with end-to-end bowel anastomosis. Patients who underwent successful USGHR were subsequently kept in the ward and observed for a minimum period of 24 hours to detect any complication or recurrence.

Statistical analysis

Data analysis was performed by a statistician using statistical software (SPSS, version 20.0). Categorical data was analyzed using Pearson's chi-square test or Fisher's Exact test. Quantitative data was analyzed using two sample independent t-test. A p-value less than 0.05 was considered as statistically significant.

RESULTS

During the course of our study, authors treated 63 children with 68 intussusceptions. Thirteen of the patients with thirteen intussusceptions underwent primary surgery due to features of peritonism and intestinal prolpase and were excluded from the study. Only 50 patients with 55 intussusceptions fell within the inclusion criteria and were thereby analysed. They included 28 males and 22 females with a male to female ratio of 1.27:1. Mean age of the patients in our study was 11.2±8.8 months with median and age range of 8 months and 3 months to 50 months, respectively. Majority 69.1% (N=38) of the patients presented to our hospital within 24 h of onset of symptoms whereas 30.9% (N=17) showed delayed presentation. Mean duration of the symptoms was 40±34.2 h with a range of 2.5-140 h. Colicky abdominal pain (100%) was the most common symptom in our patients followed by vomiting (98.2%) and palpable abdominal mass (94.5%). Table 1 shows the clinicalfeatures of the patients in our study.

Table 1: Clinical presentation of patients.

Clinical Features	Frequency (%)
Abdominal pain	55 (100%)
Vomiting	54 (98.2%)
Palpable abdominal mass	52 (94.5%)
Red currant jelly stool	41 (74.5%)
Dehydration	23 (41.8%)
Fever	16 (29.1%)
Abdominal distension	8 (14.5%)

Out of 55 intussusceptions, forty-seven (85.5%) were ileocolic (Figure 1), 5 (9.1%) were colocolic and 3 (5.5%) were ileoileal. Table 2 shows the various types of intussusceptions along with their outcomes.

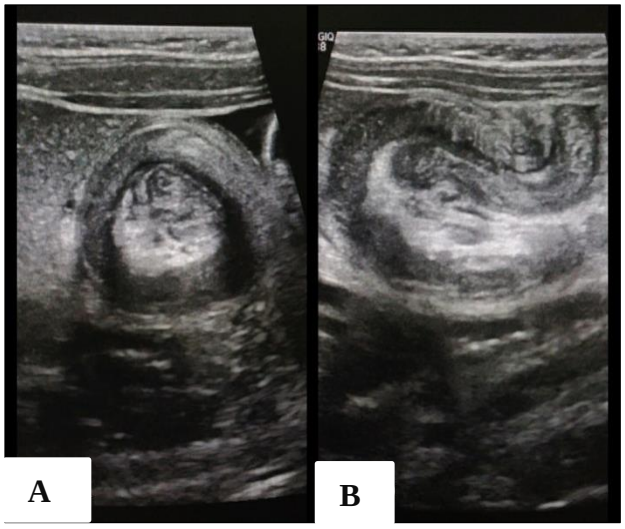

Figure 1: Transverse (A) and longitudinal (B) sonographic images in an 8 month old patient with ileo-colic intussusception showing the characteristic Target and pseudokidney signs, respectively.

Table 2: Various types of intussusceptions and their outcome.

Types of intussusception	Successful reduction	Failed reduction
Ileocolic	39	8
Colocolic	4	1
Ileoileal	2	1

No pathologic lead point was identified in our subjects. Out of 55 procedures of ultrasound guided hydrostatic reduction of intussusceptions, forty-five (81.8%) had successful outcome while 10 (18.2%) cases had partial or failed reduction, necessitating surgical treatment. Of those with failed reduction, 3 developed intra-procedural bowel perforation and were confirmed to be due to bowel gangrene at surgery, 3 patients had gangrenous bowel without perforation. Rest of the 4 cases with failed reduction showed hyperplasia of Peyers patches along with marked edema of the intussusceptum apex.

Amongst those with failed USGHR with subsequent operative management, eight patients underwent bowel resection whereas two patients had manual reduction. USGHR of intussusceptum was more successful in those with early presentation to hospital following symptom onset in comparison to those with delayed presentation, although the difference was not statistically significant, p=0.181, (Table 3).

Table 3: Factors influencing ultrasound guided hydrostatic reduction of intussusceptions.

Variables	Outcome of non-operative reduction		p value
	Successful	Failed	
Duration of abdominal pain in hours			
< 24	33	5	0.181
>24	12	5	
Age (in months)			
3-12	31	8	0.780
13-50	14	2	
Gender			
Male	25	6	1.000
Female	20	4	

Likewise, age and gender of the patient had no impact on the successful outcome of reduction, p >0.05 (Table 3). During follow up period, four patients (8.9%) developed recurrent intussusception. Two patients developed single episode of recurrence within the initial 24 h after reduction while the other two developed two episodes of recurrence following initial reduction 4 to 6 months apart.

Those with two episodes of recurrence were further evaluated with oral contrast enhanced computerized tomographic (CECT) scan of the abdomen for lead point and were found to be unremarkable for any mural or luminal pathology of the bowel. All recurrence cases were successfully managed non-operatively.

The duration of the procedure (USGHR) in our series ranged between 4 min to 23 min, with a mean of 8.5±4.5 min. Most (27/45) of the intussusceptions were successfully reduced at the time of first attempt of the procedure the mean duration of hospital stay amongst those who had successful reduction was 2.0±0.5 days and those with failed reduction and subsequent operative management was 9.5±2 days. The difference was statistically significant, p=0.0015. Our series had no mortality with a 66.2% (45/68) reduction in operative management of intussusception following ultrasound guided hydrostatic reduction.

DISCUSSION

Non-operative reduction of intussusception using barium, saline or air enema under ultrasound or fluoroscopic guidance has now become the gold standard treatment of intussusception in the developed world. With the widespread adoption of hydrostatic reduction under ultrasound guidance, reported data indicates colossal success rates commensurate to, or superior than barium or pneumatic reduction under fluoroscopic guidance. The acceptance of USGHR as the treatment of choice has been lagging in many developing countries including India due to delayed patient presentation, mismanagement of patients at peripheral health care facilities due to lack of equipment and expertise to undertake the procedure.[4,5,10] Moreover, surgical treatment in developing countries is associated with high mortality rate in comparison to its developed counterparts, thus emphasizing the need for more developing nations to adopt USGHR.[5,17]

In order to benefit from non-operative reduction, health care professionals need to have high index of suspicion in addition to public awareness so that misdiagnosis and delayed presentation can be prevented. In this study, USGHR was able to reduce the rate of operative reduction by 66.2%, which is commensurate to that obtained by Wakjira et al. In the present series, 81.8% of the procedures were successful, comparable to the data of other workers who reported success rate of USGHR to be more than 82%. A low success rate of 55.6% for USGHR was found by Ogundoyin et al. in Nigeria whereas Wakjira et al. recently recorded a 87.2% reduction rate in their series. [4,10,15,18-21] A 100% success rate for hydrostatic reduction with saline was achieved by Sanchez et al. in their series of 14 children. Recurrence rate following successful non-operative reduction of intussusception varies in literature from 5 to 20%, with a greater incidence in those with pathological lead point. [22,23]

Majority of the recurrences primarily occur within the first 48 hours but recurrences as late as 1.5 years afterwards have been reported.[24-26] Recurrence rate in our study was 8.9 %, which was commensurate with other studies.[4,9,20,27]

Recurrent intussusception, even if it occurs multiple times, is responsive to treatment with USGHR.[23] It is pertinent to mention that in our series two patients developed two late recurrences, each one 4 to 6 months apart.

These children after evaluation with oral contrast enhanced computed tomography scan of the abdomen

revealed no mural or luminal pathology of the intestines. USGHR of the insussusception was successful in all these recurrent cases. From this, authors conclude that majority of the intussusceptions in children are idiopathic and amenable to reduction with saline under ultrasound guidance. Non-operative reduction under ultrasound guidance should therefore be preferred even in patients with multiple late recurrences provided they fall under the inclusion criteria for the procedure.

In our study, age and gender of the patients had no effect on the successful outcome of hydrostatic reduction, which is commensurate with most studies.[4,16,20] Nonetheless, Nayak et al, and Eklof et al, noticed a lower rate of successful reduction in young infants in comparison to older children.[19,28] They opined that this could be due to greater competency of ileo-caecal valve in the very young, which impedes the flow of contrast into the terminal ileum thereby lowering the rate of successful reduction. In addition, duration of symptoms of the patient is also an important prognosticator of the outcome in non-operative reduction of intussusception.

Wong et al, in their series of non-operative reduction of intussusception found that a mean duration of 2.3 days had no influence on the successful outcome of reduction. [29] This is in contradistinction to the study done by Chung et al. who found that long duration of symptoms (>24 h) was a harbinger of surgical reduction. Khorana et al, reported that intestinal viability in lieu of longstanding duration of symptoms is an important prognostic factor for failed reduction.[27,30]

In our series, the duration of symptoms had no influence on the successful outcome of non-operative reduction of intussusceptions, which is in resonance with some series.[19,20,27,31] Bowel perforation, as a complication of USGHR, has a low incidence in the literature, ranging from 0 to 10%.[4,5,18,21]

Over distension of the bowel with fluid is always a risk factor for perforation, however, majority cases of perforation with USGHR are believed to have happened before the procedure, making it unavoidable.[19]

During the procedure, majority of the bowel perforations occur as a result of gangrenous intestines instead of high intraluminal pressure from saline instillation. In our study, three patients developed bowel perforation during the procedure and were found to have gangrenous bowel at laparotomy, which was initially missed during the clinical examination of the patients.

This pertinent finding emphasizes the need for proper patient selection clinically along with the use of color Doppler ultrasound to evaluate the vascularity of the bowel antecedent to reduction. Nonetheless, bowel perforation due to overdistension or overlooked intestinal gangrene should not deter the application of USGHR of intussusception in limited resource hospitals with no facilities for hydrostatic pressure control.

Premedication of the children with chlorpromazine prior to the procedure yielded higher success rates according to some studies.[6,32] A positive correlation between the use of premedication and successful outcome of the procedure was found by Flaum et al, Bia et al, used wintermin (1mg/kg) as premedication in their study and documented a success rate of upto 96%.[20, 33]

A study done by Mensah et al, recorded a success rate of 75% regardless of the use of ketamine hydrochloride (1-2 mg/kg) as premedication. [9] Authors did not administer premedication to the patients in our series. In our study, majority of the patients with failed reduction had gangrene of the bowel prior to presentation at our centre, so the use of sedatives would not have increased the success rate of the procedure.

CONCLUSION

USGHR of intussusceptions using normal saline is an effective non-operative method of treating intussusceptions in children with a successful outcome of 81.8 % in our study. The procedure is safe, simple and economical in a limited resource setting. authors recommend that USGHR should be adopted as the procedure of choice for the management of intussusceptions in children in health care facilities where amenities and expertise are at one's disposal.

Limitations of this study had some limitations in terms of small sample size of 60 children with 68 intussusceptions and limited experience in performing USGHR.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee 1964 Helsinki declaration and its later amendments ar comparable ethical standards.

REFERENCES

1. Beasley SW, Hutson JM, Auldist AW. Essential paediatric surgery. Arnold; 1996.
2. Hamby LG, Fowler CL, Pokony WJ. Intussusception. In: Donellan WL, editor. Abdominal Surgery of Infancy and Childhood. Luxembourg: Harwood Academic Publishers; 2001. 42/1-42/19.
3. Columbani PM, Scholz S. Intussusception. In: Coran AG, Adzick NS, Krummel TM, Laberge JM, Shamberger RC, Caldamone AA, editors. Pediatric Surgery. Philadelphia: Saunders; 2012.1093-110.
4. Ogundoyin OO, Atalabi AM, Lawal TA, Olulana DI. Experience with sonogram – guided hydrostatic reduction of intussusception in children in south

West Nigeria. J West Afr Coll Surg. 2013;3(2):76-88
5. Talabi AO, Sowande OA, Etonyeaku CA, Adejuyigbe O. Childhood intussusception in Ile – Ife: what has changed? Afr J Paediatr Surg. 2014;10(3):239-42.
6. Kim YG, Choi BI, Yeon KM, Kim JW. Diagnosis and treatment of childhood intussusception using real time ultra-sonography and saline enema: preliminary report. J Korean Soc Med Ultrasound. 1982;1(1):66-70.
7. Khong PL, Peh WC, Lam CH, Chan KL, Cheng W, Lam WW, et al. Ultrasound-guided hydrostatic reduction of childhood intussusception: technique and demonstration. Radiograph. 2000 Sep;20(5):e1.
8. Alebossein M, Babaheidarian P, Salamati P. Comparison of different modalities of reducing childhood intussusception. Iran J Radiol. 2011;8(2):83-7.
9. Mensah Y, Glover-Addy H, Etwire V, Appeadu-Mensah W, Twum M. Ultrasound guided hydrostatic reduction of intussusception in children at Korle Bu Teaching Hospital: An initial experience. Ghana Med J. 2011;45(3):128-31.
10. Wakjira E, Sisay S, Zember J, Zewdneh D, Gorfu Y, Kebede T, et al. Implementing ultrasound-guided hydrostatic reduction of intussusceptions in a low-resource country in sub-Saharan Africa: our initial experience in Ethiopia. Emerg Radiol. 2018;25(1):1-6.
11. Marinkovic S, Bucarica S, Jeckovic M, Skoric S, Antic J, Starcevic Z. Ultrasound- guided water enema for reduction of childhood intussusception. Med Pregl. 2007;60(11-12):605-9.
12. Cheng KL, Saing H, wc P, Mya GH, Cheng W, Khong PL, et al. Childhood intussusception: ultrasound-guided Hartmann's solution hydrostatic reduction or barium enema reduction. J Pediatr Surg. 1997;32(1):3-6.
13. Bekdash B, Marven SS, Spigg A. Reduction of intussusception: defining a better index of successful non-operative treatment. Pediatr Radiol. 2013;43(6):649-56.
14. Ocal S, Cevik M, Boleken ME, Karakas E. A comparison of manual versus hydrostatic reduction in children with intussusception: single-center experience. Afr J Paeditr Surg. 2014;11(2):184-8.
15. Ahmad MM, Wani MD, Dar HM, Mir IN, Wani HA, et al. An experience of ultrasound guided reduction of intussusception at a tertiary care Centre. S Afr J Surg. 2016;54(1):10-3.
16. He N, Zhang S, Ye X, Zhu X, Zhao Z, Sui X. Risk factors associated with failed sonographically guided saline hydrostatic intussusception reduction in children. J Ultrasound Med. 2014;33(9):1669-75.
17. Bode CO. Presentation and management outcome of childhood intussusception in Lagos: a prospective study. Afr J Paed Surg. 2008;5(1):24-8
18. Digant SM, Rucha S, Eke S. Ultrasound guided reduction of an ileocolic intussusception by a hydrostatic method by using normal saline enema in paediatric patients: a study of 30 cases. J Clin Diagn Research. 2012;6(10):1722.
19. Nayak D, Jagdish S. Ultrasound guided hydrostatic reduction of intussusception in children by saline enema. Indian J Surg. 2008;70(1):8-13.
20. Flaum V, Schneider A, Ferreira CG, Philippe P, Sancho CS, Lacreuse I, et al. Twenty tears experience for reduction of ileocolic intussusceptions by saline enema under ultrasound control. J Pediatr Surg. 2015;51(1):179-82.
21. Gfoerer S, Fiegel H, Rolle U. Ultrasound-guided reduction of intussusception: a safe and effective method performed by pediatric surgeons. Pediatr Surg Int. 2016;32(7):679-82.
22. Sanchez TR, Doskocil B, Stein-Wexler R. Nonsurgical management of intussusception: retrospective comparison between sonographic and fluoroscopic guidance. J Ultrasound Med. 2015;34(1):59-63.
23. Ko HS, Schenk JP, Troger J, Rohrschneider WK. Current radiological management of intussusception in children. Eur Radiol. 2007;17(9):2411-21.
24. Daneman A, Alton DJ, Lobo E, Gravett J, Kim P, Ein SH. Patterns of recurrence of intussusception in children: a 17-year review. Pediatr Radiol. 1998;28(12):913-9.
25. Ein S. Recurrent intussusception in children. J Pediatr Surg. 1975;10:751-5.
26. Eshel G, Barr J, Heiman J, Bistritzer T, Broide E, Klin B, et al. Incidence of recurrent intussusception following barium versus air enema. Acta Pediatr. 1997;86(5):545-6.
27. Khorana J, Singhavejsakul J, Ukarapol N, Laohapensang M, Siriwongmongkol J, Patumanond J. Prognostic indicators for failed nonsurgical reduction of intussusception. Ther Clin Risk Manag. 2016;12:1231-7.
28. Eklof OA, Johanson L, Lohr G. Childhood intussusception:hydroststic reducibility and incidence of leading point in different age groups. Pediatr Radiol. 1980;10(2):83-6.
29. Wong CWY, Chan IHY, Chung PHY, Lan LCL, Lam WWM, Wong KKY, et al. Childhood intussusception: 17-year experience at tertiary referral Centre in Hong Kong. Hong Kong Med J. 2015;21(6):518-23.
30. Chung JL, Kong MS, Lin JN, Wang KL, Lou CC, Wong HF. Intussusception in and children: risk factors leading to surgical reduction. J Formos Med Assoc. 1994;93(6):481-5.
31. van de Ende ED, Allema JH, Hazebroek FWJ, Breslau PJ. Success with hydrostatic reduction of intussusception in relation to duration of symptoms. Arch Dis Child. 2005;90(10):1071-2.
32. Rohrschneider WK, Troger J. Hydrostatic reduction of intussusception under US guidance. Pediatr Radiol. 1995;25(7):530-4.
33. Bia YZ, Qu RB, Wang GD, Zhang KR, Li Y, Huang Y, et al. Ultrasound- guided hydrostatic reduction of

intussusception by saline enema: a review of 5218 cases in 17 years. Am J Surg. 2006;192(3):273-5.

Cite this article as: Shiekh Y, Khan AJ, Bhawani SS. Ultrasound guided hydrostatic reduction of intussusception: suitability and effectiveness with factors affecting its successful outcome. Int J Adv Med 2019:6:1567-73.