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ORIGINAL ARTICLE

Ultrasound guided hydrostatic reduction of intussusception in children by saline enema: our experience

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Abstract

Background Intussusception is a common cause of acute intestinal obstruction with potentially serious complications. The treatment of choice is an attempt at initial non-operative treatment.

Aim The purpose of the study was to evaluate the efficacy of the technique of hydrostatic reduction of intussusception using saline enema and ultrasound being practiced in our institute; the secondary goal was to identify patient subset in which it is more successful.

Material and Methods The case records of all patients treated for intussusception in our institute from 1st January 2000 to 30th June 2007 were retrospectively analyzed to collect information. All patients with ultrasound diagnosed intussusception that were not having signs of shock or peritonitis were treated with normal saline enema under ultrasound guidance. Failure of three such attempts was an indication for operation.

Result and Conclusions We found that this technique is easy, safe and extremely effective in treating intussusception in children. The success rate was 81.37% (83 out of 102 cases) and mortality rate was 1.2%. Ileoileocolic type of intussusception failed enema reduction more often (statistically significant; P value = 0.0032) while older patients (statistically significant, P value = 0.001) had higher success rates with the technique. Patients who had colocolic type of intussusception (P value = 0.29) and patients who present early (P value = 0.262) appear to have higher success rates but this was not statistically significant.

Keywords Intussusception · Therapy · Ultrasonography

Introduction

Intussusception is a common cause of acute intestinal obstruction in infants; it is also seen in older children and adults occasionally [1]. Intussusception accounted for 16% of all cases of intestinal obstruction in children in one study from India [2]

For reasons that are unclear, intussusception is relatively uncommon in Asia and Africa despite the high incidence of infective diarrheal diseases in children found in these regions [1, 2]. Intussusception is managed by an initial attempt at non-operative reduction with either barium enema or saline water enema or air-insufflation through rectum; failure of multiple attempts or signs of peritonitis are indications for operation.

The best technique, the best imaging modality, patient selection criteria and the optimum protocol to be followed

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are still under debate; each method has its proponents and detractors. Although from western countries there are a number of studies which document the experience of treating intussusception with hydrostatic reduction, from India there are only a few series documented.

In our institution we have been using ultrasound guidance for saline enema to reduce intussusception for the last 7–8 years. The aim of this study was to evaluate this technique; the secondary goal of this study was to identify the subset of patients in which it was more successful.

Material and methods

The case records of all patients treated for intestinal intussusception between January 1st 2000 and June 30th 2007 were retrospectively analyzed.

All patients with sonographically diagnosed intussusception were admitted to Paediatric Surgery ward, resuscitated and shifted to radiology suite for saline enema. Written informed consent was obtained from the parents for this procedure.

With the patient lying in left lateral position a 16–18 Fr Foley's catheter was introduced into the rectum till its Y-piece and the balloon was inflated with 20–30 ml of saline. Then the Foley's catheter was pulled back till the balloon hitched snugly in the rectum and the buttocks were taped together to maintain anal seal.

The radiologist used high resolution ultrasound Justvision400 (Toshiba Corporation, Japan) to image the intussusception. A resident from Pediatric Surgery Unit remained in attendance in the suite. Parents of the child restrained the child so as to facilitate the procedure. Sedation in the form of Injection Diazepam 0.05 mg / Kg given slow intravenously was sometimes used to calm the patient. The enema was performed by holding the container with normal saline about 100–150 cm above the patient and letting the fluid flow down by gravity into rectum through an intravenous-infusion set. No pump was used and no pressure monitors were connected to this enema circuit.

A maximum of three attempts were made; each attempt was approximately 15–20 minutes in duration, between two attempts 6–8 hours gap was given. Patients presenting with features of peritonitis or in shock were excluded from the study. Successful reduction was defined as disappearance of the intussusceptum and free reflux of saline into the terminal ileum. All patients who had successful hydrostatic reduction were kept under observation for 24 hours and gradually advanced on diet thereafter as their symptoms improved. Review ultrasound study was done prior to discharge usually on the 4th–5th day. The patients were called back at 1 and 6 months after discharge to outpatient department for follow-up.

All results were analyzed using appropriate statistical tools with the software SPSS version 10.0.

Results

A total of 102 patients were treated for USG-confirmed intussusception in the Pediatric Surgery Unit of our institution in the mentioned time period. Out of these, 64 patients (62.74%) were males and 38 patients (37.26%) were females; the male: female ratio was 1.7:1. The median age in our series was 7 months while mean age was 15.62 ± 26.07 months (mean ± standard deviation); Table 1 displays all the observed data. The youngest child was a newborn male aged 17 days while the oldest were two male children 4 years of age. 83 patients had successful reduction with saline enema while in 19 patients it failed and these had to be operated upon; the success rate achieved with the procedure was 81.37 %.

The duration of symptoms ranged from 2 hours to 144 hours, some patients were referred to our institute after few days of treatment elsewhere. Because of such wide range the statistical data appears skewed. The standard deviation actually predates the birth and the onset of symptoms in most of the groups in Table 1; this is merely a statistical artifact.

One 5 month old male baby developed shock and features of peritonitis soon after enema; he was resuscitated but rapidly deteriorated and died within 10 hours; the patient could not be taken up for surgery. Thus the mortality rate with the procedure was 1.20 %.

One patient had colocolic intussusception diagnosed 6 days after Swenson's operation done for Hirschsprung's disease; it failed enema reduction and had to be operated upon. Interestingly we had two patients of less than 1 month

Table 1 Summary of findings

	All patients	Group 1 (hydrostatic reduction successful)	Group 2 (Hydrostatic reduction unsuccessful)	
Number of patients	n=102	n=83	n=19	
Age (in months)	15.62 ± 26.07	17.63 ± 28.52	6.87 ± 2.94	P value = 0.001
Duration of symptoms (in hours)	16.59 ± 20.02	14.99 ± 16.18	23.58 ± 31.51	P value = 0.262
Recurrence rate	4.9%	4.81%	5.26%	
Mortality rate	0.98%	1.20%	0.00%	

age; a newborn male baby of 17 days and a female baby of 30 days age. Both had ileocolic intussusception and both were managed by successful hydrostatic reduction. No lead points were identified in either of them.

Fig. 1 shows the distribution of different types of intussusception in our patients in both the groups. The commonest type noticed in our series was ileocolic (47%) followed by colocolic (36%) followed by ileoileocolic (10%), in 7% of cases the sonologist could not identify the specific type on ultrasound scanning.

Out of these types, patients having ileoileocolic type had a statistically significant risk of failing to reduce with hydrostatic reduction (Chi-square test; Odd's ratio = 0.20, RR = 0.29, 95% confidence limits, P value = 0.0032). Hydrostatic reduction appears to be more successful in colocolic type but this failed to reach statistical significance (Chi-square test; Odd's ratio = 0.56, RR = 0.83, 95 % confidence limits, P value = 0.29) probably because of the small numbers of colocolic intussusceptions in this study; a larger study is needed.

6 out of the 19 patients who were operated had lead points identified at laparotomy. In 3 cases it was polyp (2 illeal and 1 colonic) and in another 3 cases it was hypertrophied Peyer's patches. 1 of the illeal polyps was found to be non-Hodgkin's lymphoma. The only patient with colonic polyp was found to be a case of Peutz-Jegher's syndrome.

Patients who failed hydrostatic reduction are younger (please see Table 1) and this was statistically significant in our series (Independent samples T-test; P = 0.001, 95% confidence interval). We also found that hydrostatic reduction appears to be more successful in patients with shorter duration of symptoms but this was not statistically significant (Independent samples T-test, P value = 0.262, 95% confidence interval).

The diagnostic sensitivity of USG for intussusception in our study was 93.13 %. During follow-up four patients who were successfully treated with saline enema were readmitted later to our institution for recurrence of intussusception hence the recurrence rate was 4.81%. Two patients had recurrent intussusception at 1 month, 1 patient at 4 months and 1 at 6 months following the initial successful treatment. All of these were successfully re-treated with hydrostatic reduction. Among the patients who had surgery, 1 patient had recurrent colocolic intussusception on 2nd post-operative day after operation (recurrence rate = 5.26%); he was successfully treated with hydrostatic reduction.

Discussion

Harald Hirschsprung of Denmark used enema to reduce intussusception in 1871 but it went largely unnoticed [3]. In 1952, Ravitch and McCune published a famous landmark

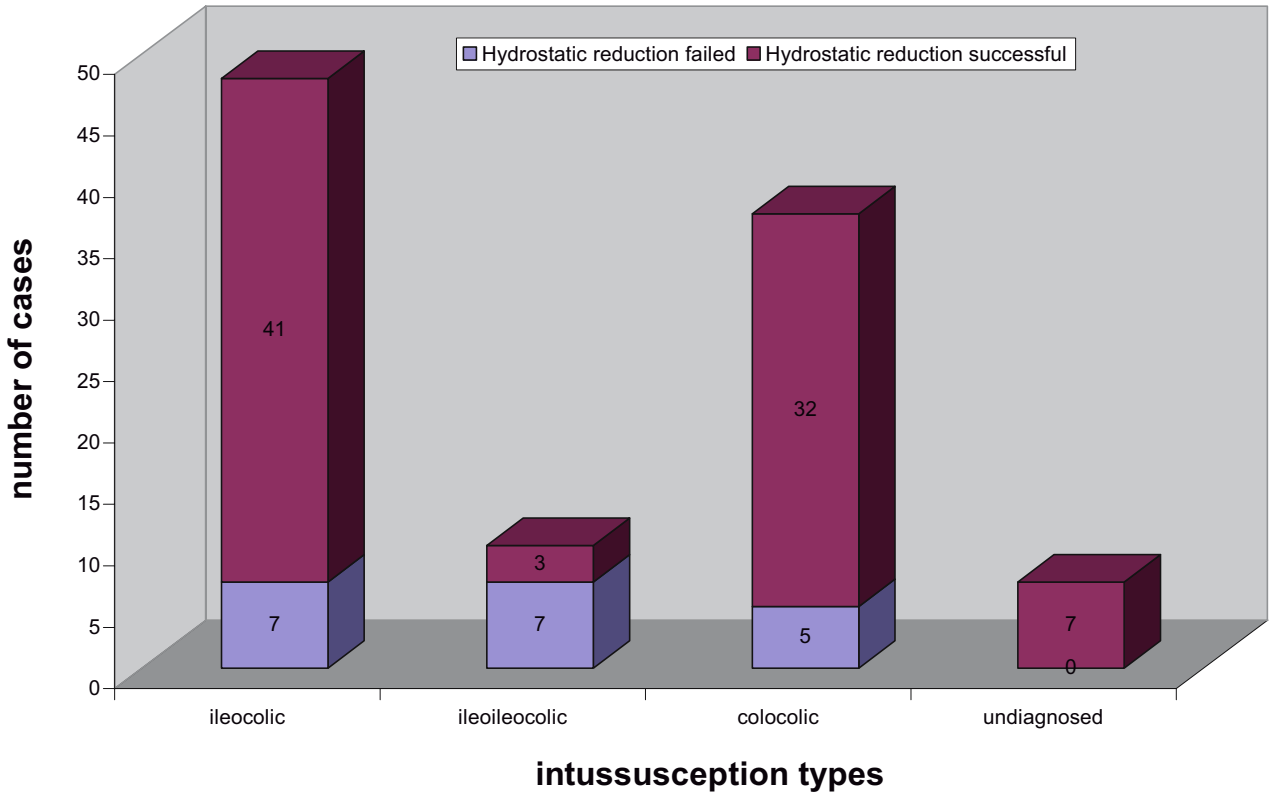

Fig. 1 Comparison of types of intussusception in the two groups

Table 2 Hydrostatic reduction of intussusception; comparison of results between some Asian and Indian studies

Setting of study	Kerala, South India [5]	Kerala, South India [6]	Punjab, North India [7]	Pondicherry This study	Saudi Arabia [8]	Iran [9]	China [10]	China [11]	Hongkong [12]	Korea [13]
Number of patients	25	50	5	102	60	76	5217	377	25	116
Success rate	96%	80%	60%	83.37%	83.3%	78.8%	95.5	95.5%	76%	85%
Complications observed	Nil	Nil	Nil	4.81% recurrence rate, Perforation in one case (1.20%)	Nil	3.8% recurrence rate, Perforation in 1 case	Milk aspiration in 2 cases, 0.17% Colonic perforation.	Nil	Nil	Nil

Table 3 Non-operative management of intussusception; comparative studies from Western countries between various methods

Saline Enema under ultrasound guidance	Air insufflation under ultrasound guidance	Barium enema under fluoroscopic guidance
	Review by del-Pozo et al [17]	
76–95% success rate 0.26% intestinal perforation rate	81–91% success rate 0.14–2.8 % intestinal perforation rate	55–90% success rate 0.39–0.7 % intestinal perforation rate
	Non-randomized comparative trial by Tellado et al [20]	
96.4% success rate No complications 1 recurrence	94.6% success rate 1 perforation 2 recurrences	81.25% success rate 1 perforation No recurrence
	Non-randomized comparative trial by Mallol et al [21]	
	88 % success rate No complications	76% success rate No complications

series from Johns Hopkins hospital in USA; they used barium sulphate enema to diagnose as well as reduce intussusception, calling this "hydrostatic reduction". Ravitch and McCune reported 73.6 % success rate, no deaths and 5.55 % recurrence rate in their original study [4].

There are relatively few papers on this technique from India and its neighboring countries compared to a large number of studies reported from USA, China, Argentina and Europe. Table 2 provides a comparison between our study and other studies from Asian countries. The study from Saudi Arabia in table 2 is the only one which used fluoroscopy to guide hydrostatic reduction by barium enema; all the rest used USG for guidance.

Radiology has contributed a lot to the treatment of intussusception. Apart from X-ray in 1895, barium contrast enema in 1920s, ultra-sound was introduced into the treatment of intussusception in the 1980s. To diagnose and provide image guidance for hydrostatic reduction of intussusception today, most centers use only high resolution ultra-sound. Its sensitivity ranges between 98–100% in various series [14].

Various sonological signs like 'target' sign, 'pseudo-kidney' sign, 'doughnut' sign and 'frond' sign etc are described in intussusception. The absence of blood-flow in mesenteric vessels on Doppler and presence of free fluid in abdomen indicates intestinal gangrene and perforation respectively even if peritoneal signs are absent; hydrostatic reduction should be avoided in these cases. The presence of small amount of fluid within the head of intussusceptum (called 'crescent' sign) and thickness of outer ring of intussusceptum measuring more than 14 mm predicts failure of hydrostatic reduction [14].

The practice of barium enema reduction under fluoroscopic guidance has the disadvantage of pathological lead-points being invisible, residual intussusception being missed and substantial dose of radiation being received by the baby. Sonography carries no risk of radiation, is cheaper since costly barium sulphate is unnecessary, can be done at bedside and is repeatable [14].

The medieval technique of rectal air-insufflation made a come-back when Fioreto and Cuestas published their experience in 1959 from Argentina [15]. Whether this is superior to hydrostatic reduction is still being hotly debated across the globe. Del-Pozo et al (Table 3) concluded that air-insufflation (see below) had higher incidence of perforation and occasionally dangerous 'tension pneumoperitoneum' was seen [16]. In another reported series air-insufflation had 2.8% intestinal perforation rate; in the same institution barium enema reduction had 2.5% intestinal perforation rate [17]. There is no good randomized controlled trial comparing enema with air-insufflation. An ongoing Cochrane meta-analysis seeks to answer this question and is currently in recruitment stage [18].

We have no experience with air-insufflation but to us it appears cumbersome as it requires complicated circuit, pump to blow air, manometers connected to the circuit to guard against over-insufflation. Hydrostatic reduction requires uncomplicated arrangements and no pressure monitoring; the intra-luminal pressure generated by the enema depends on viscosity of fluid and height of the fluid column, both of these are known prior to the procedure and will not change during it [16].

Intestinal perforation due to over-insufflation with air or fluid is a risk but most cases of perforation with reduction are said to have occurred before the procedure and as such these are "unavoidable" [4, 16, 17, 21].

Most studies yield low successful reduction rates for ileo-cecal or ileoileocolic intussusception and higher rates for colocolic type of intussusception; this has never been adequately explained [4, 14, 15, 16]. One study in which intracolonic pressure generated during air-insufflation to reduce intussusception was studied found "the area of greatest resistance (to hydrostatic reduction) is the region of ileocecal valve" [21]. This might explain why ileocolic and ileoileocolic type of intussusceptions reduce so poorly.

Duration of symptoms and success of hydrostatic reduction has been studied in one study previously; the authors concluded that "duration of symptoms does not influence success rate with hydrostatic reduction" [22]. In our patients, however, short duration of presentation was associated with significantly better results.

One study investigated the relative success rates in different age-groups and found that children above 5 years age had highest incidence of pathological lead-points and lowest reduction rates, children below 1 year age also had low success rates in this study but the incidence of lead-points compared to other patients was the same; the authors failed to explain this [23]. In our series the age of patients who had successful reduction had higher age and this was statistically significant. The number of patients in this study is too small to analyze age-group wise; a larger study will be needed.

Lanocita was the first to report in 1980 a case in which an attempt at hydrostatic reduction failed initially and then succeeded after use of intravenous glucagon [24]. Some authors report better success if an anti-spasmodic (intravenous glucagon) or sedation was given during the procedure but this is not seen in all studies [14, 15, 16].

We never used glucagon and only occasionally used sedation. In our experience older children and those who did not have ileoileocolic type of intussusception have the best results. Hydrostatic reduction may fail more often in children who present late.

Conclusion

Ultrasound guided saline enema is safe and effective in treating intussusception in children with low rate of complications. The success rate of 81.37 %, recurrence rate of 4.81% and intestinal perforation rate of 0.98 % is acceptable and compares favorably with other reported series. Younger children and those who had ileoileocolic type of intussusception yielded lower success rates. It appears that early presentation and colocolic type of intussusception may predict higher success rates with this technique.

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