Original Article

Early experience with ultrasound guided pneumatic reduction of intussusception using locally assembled equipment in Nepal

Suman Bikram Adhikari

Department of Paediatric Surgery, Nepal National Hospital, Kathmandu, Nepal.

Correspondence: Dr. Suman Bikram Adhikari, Department of Paediatric Surgery, Nepal National Hospital, Kathmandu, Nepal.

E-mail: sumanchetri@hotmail.com

Abstract

Introduction: Intussusception is one of the commonest emergency conditions in children. Pneumatic reduction of intussusception, a minimally invasive technique, has a higher success rate and lower incidence of complications as compared to barium enema and hydrostatic reduction and also omits the need for unnecessary laparotomy. The aim of this study was to evaluate the results of the pneumatic reduction in our hospital as a treatment of idiopathic and pediatric ileocolic intussusception and to identify the pretreatment factors associated with pneumatic reduction failure.

Methods: This was a prospective analytical study. A total of 12 children were enrolled in the study between January to November 2018 at Nepal National Hospital, Kathmandu. Patients were given air enema under ultrasound-guidance using locally assembled equipment. All procedures were performed under intravenous anesthesia. The intraluminal pressure was monitored with a pressure gauge and was not permitted to go above 100 mmHg. A total of three attempts of 3 minutes each were allowed.

Results: Average age of the patients was 2.7 years, with a male-female ratio of 3:1. Eleven (92%) of the cases were successfully reduced while 1 (8%) case failed to reduce. No bowel perforation occurred in this study. The mean duration of symptoms before presentation was 42 hours. The mean length of intussusceptum was 3.058 cm. the mean duration of pneumatic reduction was 1.97 minutes and total intervention time i.e. from induction of anesthesia to reversal from anesthesia was 18.55 minutes.

Conclusion: The technique described is easy to assemble, safe and effective. I recommend it for regular use in pneumatic reduction of intussusception, especially in centers with limited resources.

Keywords: Intussusception; Pneumatic reduction.

Introduction

Intussusception is a major cause of intestinal obstruction in early childhood. It is defined as a bowel condition wherein one part of intestine invaginates into another. 75% of cases occur in children under 2 years of age, 90% before 3 years.[1] However, the estimated incidence ranges between 5 and 40/10000 live births according to the studied population.[2]

The diagnosis of intussusception, according to the clinical case definition for the diagnosis of acute intussusception proposed by the Brighton Collaboration Intussusception Working Group, can be determined by ultrasound with 98-100% accuracy by an experienced examiner.[3] Currently, treatment modalities for intussusception include both non-operative and operative procedures. A non-operative procedure will likely be performed if no contraindications

are present, which include: signs of peritonitis, perforation and a hemodynamically unstable patient in spite of adequate resuscitation. [4–5] Operative procedures will be given when non-operative treatment is contraindicated or has failed.

Timely, effective reduction of intussusception is critical to prevent complications like bowel necrosis, perforation, peritonitis, shock, and even death.[6] Pneumatic reduction of intussusception, a minimal invasive technique, has a higher success rate and lower incidence of complications as compared to barium enema and hydrostatic reduction, and also omits the need of unnecessary laparotomy.[7] The aim of this study was to evaluate the results of the pneumatic reduction in our hospital as a treatment of idiopathic pediatric ileocolic intussusception and to identify the pretreatment factors associated with pneumatic reduction failure.

Methods

A prospective analytical study was conducted in Nepal National Hospital. 12 subjects with intussusception were treated with pneumatic reduction from January 2018 to November 2018.

Candidates for inclusion in this study were children from 6 months to 6 years who were diagnosed with intussusception and duration of symptoms of <4 days, while subjects with features of peritonitis, shock, radiographic evidence of perforation with free air, patient passing red-currant jelly stool for > 24 hours that required surgery and refused to give consent for pneumatic reduction were excluded. Ultrasound was used for confirmation of intussusception conducted by an experienced radiologist according to the clinical guidelines for the diagnosis of intussusception. The data collected included demographic data (age and sex), symptoms and signs (abdominal pain, vomiting, fever, constipation, Per-rectal bleeding, abdominal lump and duration of symptoms), length of intussusceptum, timing of reduction of intussusception and total duration of procedure, i.e. from induction of anesthesia to reversal from anesthesia.

Informed consent was taken from the legal guardian mentioning three attempts of pneumatic reduction at an interval of three minutes each and if failed then convert to laparotomy. Ethical clearance was taken from Hospital Ethical Committee. The procedure was performed under total intravenous anesthesia and under ultrasound guidance throughout the procedure. Pneumatic reduction was performed by paediatric surgeon. A Foley catheter was inserted via anus of the subjects and buttock was taped to prevent air leakage. Locally assembled reduction equipment (Figure 1) was used to introduce air enema. The intraluminal pressure was monitored with a pressure gauge and was not permitted to go above 100 mmHg in three separate attempts each lasting three minutes. The success of reduction was determined in three ways. Firstly, it was determined by the disappearance of the intussusceptum after passing the ileocecal valve. Secondly, demonstration of air passing in small bowel loops. Thirdly, demonstration of the ileocecal valve. In the case of ileoileal intussusception, successful reduction included the disappearance of intussusceptum and demonstration of air passing in proximal bowel loops. Failed reduction was defined as a remaining intussusception mass where air could not pass from cecum to ileum through ileocecal valve after reduction procedure. In this case, an ultrasound was performed again to confirm the failure of the reduction.

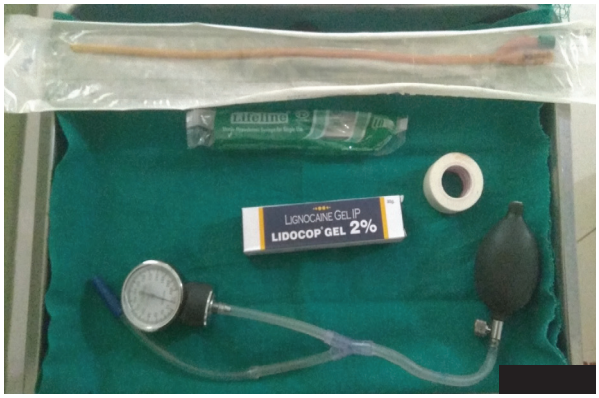

Figure 1. Locally assembled equipment used for pneumatic reduction

Results

A total of 12 subjects with intussusception were treated with pneumatic reduction over a period of 11 months. None of the patients were excluded from this study. Eleven (92%) of the cases were successfully reduced while 1 (8%) case failed to reduce. No bowel perforation occurred in this study. Mean age of subjects was 2.7 years with a range from 7 months to 6 years (Table 1). The male to female ratio was 3:1. Eighty-three percent of subjects (10) had ileocolic and seventeen percent subjects (2) had ileoileal intussusception (Table 2). Abdominal pain was present in all cases, followed by vomiting (58%), fever (42%), abdominal lump (42%), Per-rectal bleeding (33%) and constipation (33%) (Figure 2). The mean duration of symptoms before presentation was 1.75 days (42 hours).

The mean length of intussusceptum was 3.058 cm. the mean duration of pneumatic reduction was 1.97 minutes and total intervention time, i.e. from induction of anesthesia to reversal from anesthesia was 18.55 minutes. The failed case was an 8 months female child who presented at day 4 with intussusceptum length of 4 cm.

Table 1. Age distribution of subjects (N=12)

	Mean	Standard deviation
Age in years Range	2.708 7 months - 6 years	1.621

Table 2. Demography presentation of subjects (N=12)

[redacted]

Table 3. Description of different study attributes

	Mean	Standard deviation
Duration of symptoms in days (Range)	1.75 (1-4)	0.5
Length of intussusceptum in cm (Range)	3.058 (1.8- 4.3)	0.79
Duration of pneumatic reduction in minutes (Range)	1.97 (1.5-2.5)	0.358
Total intervention time in minutes from induction to reversal (Range)	18.55 (15-35)	5.125

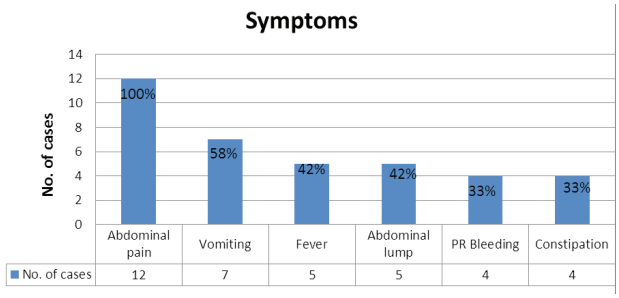

Figure 2. Bar diagram showing different symptoms

Discussion

Air enema reduction under the guidance of fluoroscopy or ultrasonography might have potential to become the principal treatment method for intussusception.[2] The results of Beres and Baird[7] evaluated air versus liquid enema reduction for intussusception in their meta-analysis and reported a success rate of 76% with pneumatic reduction versus 66% with liquid reduction, and they suggested that air enema pressures are higher than liquid enema pressures that result in higher success rates. Khorana et al[8] found in their study that the success rate of pneumatic reduction was 1.48 times more than that of hydrostatic reduction even though they affirmed that both pneumatic and hydrostatic reduction can be performed safely according to the experience of the radiologist or pediatric surgeon and hospital setting.

Beres and Baird[7] and Gray et al[9] confirmed that the perforation rate of pneumatic or hydrostatic reductions was not significantly different and they were unable to detect factors associated with this complication. However, pneumatic reduction of intussusception entails less radiation exposure and lower risk of peritoneal contamination if perforation occurs as air, carbon dioxide, or oxygen is insufflated through a rectal catheter while liquid reduction is performed with iodinated contrast material, barium, saline, or sometimes, water carrying the risks of electrolyte disturbances and contamination.[2]

The success rate of pneumatic reduction varies from one author to another, ranging from 76% to 87.2%.[7, 10-12] In this study, the success rate was ninety-two percent (11 subjects). Eight percent (One subject) failed pneumatic reduction. The failed case was 8 months female child who presented on day 4. Delay in presentation and age less than 1 year, rectal bleeding, constipation and abdominal mass and location of mass (left over the right side) are common significant risk factors for failed reduction.[13]

Other similar studies in the past also pointed age as a risk

factor for failed reduction. Fallon et al[14] and Tota-Maharaj et al[15] stated that age less than one year was significantly associated with failed reduction. Foten et al[14] assume that this result may be attributed to the small caliber of the small bowel found in young children so as a result, the intussusception was difficult to reduce. But in this study, out of 3 subjects who were less than 1 year of age, only one encountered failed reduction. The same patient had other factors also which presumably caused failed reduction like delayed presentation.

The symptoms complex of abdominal pain, vomiting, and passage of bloody stool may mimic gastroenteritis and other causes of acute abdomen in children. This often leads to initial misdiagnosis and late referral. Wong et al[16] found that a mean duration of symptoms of 2.3 days did not affect success rate of the reduction whereas Reijnen et al[17] stated that duration of symptoms of 48h was a significant predictor of failure of pneumatic or hydrostatic reduction. In this study, the mean duration of symptoms was 42 hours (1.75 days). Per rectal bleeding for more than 24 hours along with an abdominal lump is associated with failed reduction. [16, 18] But, it is well stated that in clinically stable children whose initial pneumatic reduction attempts failed, it is safe to repeat the procedure after 30 minutes to 2 hours. However, a long duration of symptoms before treatment directly leads to a loss of intestinal viability.

Most cases were ileocolic type followed by ileoileal in this study. No pathological lead points were detected in this study. The mean length of intussusceptum in this study was 3cm. Larry et al[10] found that the mean length of intussusceptum was 4.7cm and stated that the length of intussusceptum is not related to failed reduction. The mean reduction time in this study was 1.97 minutes and total intervention time i.e. from induction of anesthesia to reversal from anesthesia was 18.55 minutes. The brevity of the procedure, the need for immobilization, patients aged older than 3 months, and painful nature of the procedure, possibility of resolution of short length intussusception with sedation only and if failed reduction then laparotomy in the same setting justifies use of anesthesia for pneumatic reduction.[19] Even though anesthesia has its own side effects, its use in pneumatic reduction is related to a better outcome. A retrospective French study described 172 patients with intussusception under general anesthesia, however, authors did not include reporting of adverse events in their analysis.[20] While comparing pneumatic reduction with and without anesthesia, pneumatic reduction success rate was significantly high with the use of anesthesia i.e. 90% vs. 79%, 92% vs. 83%, 94.4% vs. 82% and 89.5% vs. 83.3% with no intestinal perforation during procedure.[20-23] These studies provided no data on the length of sedation and recovery phases.

There are some limitations in this study. This study is conducted in a single institute with a small sample size and short time frame. Taping buttocks lack proper seal at anus through which insufflated air may leak. Faecal matter present in colon inhibits air entry and hand aneroid device provides pulsatile airflow and inconsistent pressure settings which may affect the efficiency of pneumatic reduction.

Conclusion

The technique described is easy to assemble, safe, reproducible, cheap and effective. I recommend it for regular use in pneumatic reduction of intussusception, especially in centers with limited resources.

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References

1. Columbani PM, Scholz S. Intussusception. In: Coran AG, Adzick NS, Krummel TM, Laberge JM, Shamberger RC, Caldamone AA, eds. Pediatric Surgery. 7th ed. Philadelphia. Elsevier; 2012. page 1093.
2. Bowker B, Rascati S. Intussusception. J Am Acad Pas. 2018;31:48-9.
3. Bines JE, Ivanoff B, Justice F, Mulholland K. Clinical case definition for the diagnosis of acute intussusception. J Pediatr Gastroenterol Nutr. 2004;39(5):511–8.
4. Ito Y, Kusakawa I, Murata Y, Ukiyama E, Kawase H, Kamagata S et al. Japanese guidelines for the management of intussusception in children. Pediatr Int. 2012;54:948–58.
5. Khorana J, Patumanond J, Ukarapol N, Laohapensang M, Visrutaratna P, Singhvejsakul J. Clinical prediction rules for failed nonoperative reduction of intussusception. Ther Clin Risk Manag. 2016;12:1411–6.
6. Waseem M, Rosenberg HK. Intussusception. Pediatr Emerg Care. 2008;24(11):793-800.
7. Beres AL, Baird R. An institutional analysis and systematic review with meta-analysis of pneumatic versus hydrostatic reduction for pediatric intussusception. Surgery. 2013;154(2):328-34.

8. 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.

9. Gray MP, Li SH, Hoffmann RG, Gorelick MH. Recurrence rates after intussusception enema reduction: a meta-analysis. Pediatrics. 2014;134(1):110-119.

10. Binkovitz LA, Kolbe AB, Orth RC, Mahood NF, Thapa P, Hull NC et al. Paediatric ileocolic intussusception: new observations and unexpected implications, Paediatric radiology. 2019;49(1):76-81.

11. Simanovsky N, Issachar O, Koplewitz B, Lev-Cohain N, Rekhtman D, Hiller N. Early recurrence of ileocolic intussusception after successful air enema reduction: incidence and predisposing factors. Emergency radiology. 2019;26(1):1-4.

12. Younes AE, Al Saeed M, Al-Jiffry BO, Abdel-Rahman T, Badr S, Abu-Duruk A._Pretreatment clinical, laboratory, and imaging predictors of the outcome of pneumatic reduction of pediatric idiopathic ileocolic intussusception. Saudi surgical journal. 2019:7(1):26-31.

13. Xiaolong X, Yang W, Qi W, Yiyang Z, Bo X. Risk factors for failure of hydrostatic reduction of intussusception in pediatric patients. Medicine (Baltimore). 2019;98(1): e13826.

14. Fallon SC, Lopez ME, Zhang W, Brandt ML, Weeson DE, Lee TC et al. Risk factors for surgery in pediatric intussusception in the era of pneumatic reduction. J Pediatr Surg. 2013;48(5):1032–6.

15. Tota-Maharaj R, Rampersad B, Indalsingh R. Barium enema reduction of intussusception in a developing country. West Indian Med J. 2010;59(5):535–9.

16. Wong CW, Chan IH, Chung PH, Lan LC, Lam WW, Wong KK et al. Childhood intussusception: 17-year experience at a tertiary referral centre in Hong Kong. Hong Kong Med J. 2015;21(6):518–23.

17. Reijnen JAM, Festen C, van Roosmalen RP. Intussusception: factors related to treatment. Arch Dis Child. 1990;65:871–3.

18. 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.

19. Green SM , Roback MG, Kennedy RM, Krauss B. Clinical practice guideline for emergency department ketamine dissociative sedation: 2011 update. Ann Emerg Med. 2011;57(5):449-461.

20. Purenne E, Franchi-Abella S, Branchereau S, Baujard C, Benhamou D, Mazoit JX. General anesthesia for intussusception reduction by enema. Paediatr Anesth. 2012;22(12):1211-1215.

21. Ilivitzki A, Shtark LG, Arish K, Engel A. Deep sedation during pneumatic reduction of intussusception. Pediatr Radiol. 2012; 42(5):562-565.

22. Feldman O, Weiser G, Hanna M, Devir O, Balla U, Johnson DW. Success rate of pneumatic reduction of intussusception with and without sedation. Paediatr Anaesth. 2017;27(2):190-195.

23. Shavit I, Shavit D, Feldman O, Samuel N, Ilivitzki A, Cohen DM. Emergency Physician–Administered Sedation for Pneumatic Reduction of Ileocolic Intussusception in Children: A Case Series. The Journal of Emergency Medicine. 2019;56(1):29-35.