



Pneumatic reduction of Intussusception in children is a good alternative option for reduction of Intussusception: A pilot study in JNIMS, Imphal, Manipur, India.

¹Chingtham Deepak Singh, ²Vishal Salam, ³Manisha Jha, ⁴Shamulailatpam Shivadutta Singh, ⁵Ashish Kumar Pandit, ⁶Abhishek DT

¹Associate professor & MChpaediatric surgeon, ²Senior resident, ³⁻⁶Post-graduate trainee
Department of General Surgery, Jawaharlal Nehru Institute of Health and Medical Sciences, Imphal

Submitted: 01-12-2024

Accepted: 10-12-2024

ABSTRACT:

Intussusception is one of the common cause of intestinal obstruction in pediatric age group. Early presentation as well as early diagnosis are very important factors for a favourable outcome. Non-operative management with pneumatic reduction, amongst many other modalities, is a well-established modality of treatment.

Objective- The main purpose was to establish that a trial of non-operative management with pneumatic reduction is a good alternative.

Materials and methods- It is a retrospective study done at a tertiary care centre in Imphal over a period of 2 years from 1st January 2021 till 31st December 2022. A total of 50 cases were studied.

Results- All 50 patients were considered for non-operative trial with pneumatic reduction unless there are obvious signs of peritonitis or shock. Twenty five patients (50%) were successfully managed with pneumatic reduction and nine (18%) others were initially approached with pneumatic reduction, but upon failure to reduce in third attempt or development of colonic perforation, were converted to laparotomy. Most of the post-operative events shows in favour of pneumatic reduction in terms of duration of hospital stay, duration for which the patient has to remain nil per oral (NPO) and also possibility of developing surgical site infection which we experienced in laparotomy patients in 20% cases. However, we face the grim possibility of recurrence of intussusception formation as presence of lead points cannot be tackled during non-operative management, which we have seen in 3 cases (6%).

Conclusion- Despite the chances of recurrence, Pneumatic reduction was concluded to be the modality with fewer complications and hence a very good alternative modality.

Keywords: Intussusception, non-operative, paediatric, pneumatic, reduction.

I. INTRODUCTION:

Intussusception is one of the common causes of Acute abdomen presenting as intestinal obstruction.[1] It is a surgical condition where almost invariably the proximal portion of the gut invaginates into an immediately adjacent segment usually the distal portion. About 90% of the cases are idiopathic [2] and Ileo-colic type with hyperplasia of Peyer's patches in terminal ileum as probable initiative factor, termed as 'lead-point' in its pathogenesis. Weaning, loss of passively acquired maternal immunity and common viral pathogens have also been implicated to play a role. It is seen in young children between 3 months and 3 years of age but usually peak at age between 5-9 months.[3] It has an incidence of 1 in every 2000 children and a fatality rate of less than 1%.[1] This condition needs to be promptly diagnosed and treated lest facing arterial obstruction, bowel necrosis and perforation. Abdominal ultrasonography is usually done as a 1st line investigation given its high sensitivity (98%-100%) and high specificity (88%-100%). It demonstrates a typical doughnut appearance of concentric rings in transverse section.[4,5] Management can be approached both surgically and non-surgically. THE non-surgical technique had its inception since the time of Hippocrates and since then various reduction procedures have been used either with use of air, water soluble contrast agents like Gastro-graffin or barium.[5-7] The procedures are generally done under the guidance of x-ray fluoroscopy or ultrasonography. Pneumatic reduction is the preferred standard treatment as it has greater ease of performing, lesser morbidity with complications and slightly higher success rate of 84% to 100%.[8-14] Operative measures are considered when the non-operative measures fails or if the child presents with features suggestive of perforation, peritonitis, deranged serum electrolytes or is in state of profound shock.[15,16]



In this study, we retrospectively aimed to review a case series done in our institute, a tertiary care centre, focussing on assessing the efficacy of C-arm guided pneumatic reduction against operative reduction with a view to express that pneumatic reduction is efficient and effective way of non-operative reduction.

II. METHODS AND MATERIALS:

Historical patient records were collected for all the children admitted in our department during the study period i.e., from 1st January 2021 till 31st December 2022 were collected and a case series analysis was done. A total of 50 cases, twenty-five each for operative and non-operative approach were taken. Patient demographics, clinical presentation, duration of symptoms, treatment modalities, cost factor, complications and duration of stay were emphasized upon. For every child admitted, a thorough history was taken, and a complete physical examination done. Along with base line blood work-up, an abdominal plain x-ray and an ultrasonography were done. All the children whose clinical and radiological findings were consistent with Intussusception were triaged either for non-operative or operative procedure. Any child who was symptomatic for more than 24 hours, frequently passing 'red-currant jelly' stool, showing features of peritonitis and shock were directly taken up for operative procedure after taking an informed consent. Parents of the children without these findings were counselled for a trial of non-operative approach but with a proper explanation and a prior informed consent that if the non-operative procedure should fail, an emergency exploratory laparotomy will be anticipated.

The method of non-operative reduction done in our institution was pneumatic reduction under the guidance of X-ray C arm machine, a SIEMENS Multi-mobil 5C. The procedures were performed by a paediatric surgeon along with surgical residents and a radiologist. In pneumatic reduction, air is insufflated with a hand held pump with a Foley's catheter (with size 16-20 Fr) attached to one end and an aneroid

Sphygmomanometer gauge attached to the side of the pump for measuring the pressure on a calibrated scale. The foley's catheter was inserted in child's rectum under the influence of intravenous Midazolam 0.1-0.2mg/kg. Air was insufflated and maintained at 100 mmHg for 5 minutes. Reduction was demonstrated by free flow of air into the terminal ileum with disappearance of caecal soft tissue mass. A maximum of three trials were attempted if no complications occur in between. If not reduced after the third attempt, it is labelled a failure and the child was prepared and put up for an exploratory laparotomy. For open reduction, a transverse subcostal incision was made at the level of umbilicus under general anaesthesia. The mass was identified, and manual reduction was achieved by Cope's method where the intussusceptum was miked out of intussusceptum. In case of necrotic intestinal segment, a resection-anastomosis was done. After a successful reduction, the child will be observed post-operatively till an episode of normal defecation.

III. STATISTICAL ANALYSIS:

Data analysis was done using Statistical packages for the social sciences (SPSS version 21.0). Numerical descriptive data were presented as mean and standard deviation. The categorical descriptive data were presented as numbers (N) and percentages (%).

IV. RESULTS:

This study was conducted in Jawaharlal Nehru Institute of Health and Medical Sciences (JNIMS), a tertiary care hospital in Imphal. A total of 50 children underwent the study during the study period.

A staggering 46 male (92%) children made up the study group which makes it quite obvious that it is more common in male sex. The highest number of patients encountered in this series were in the age group of 1 to 3 years (28%) with a mean age of around two and half years.

Table 1: Demographic profile

Age group	Pneumatic reduction		Laparotomy	
	Male	Female	Male	Female
0-6 months	0	0	2	0
6 months-1 year	8	1	2	0
1-3 years	10	2	1	1
3-5 years	3	0	10	0
>5 years	3	0	6	0
Total	25		25	



We observe in our study that children who presented within 24 hours (14%) were safely intervened with only pneumatic dilatation and it shows a promising result cases in all cases presented within 48 hours but for one. But when

the time of presentation crosses 48 hours, most of the cases (77%) presents with features of peritonitis or failure of pneumatic dilatation warranting laparotomy.

Table 2: Time of presentation reflecting mode of management

Duration of symptoms	Pneumatic reduction	Laparotomy
0-24 hours	7	0
24-48 hours	11	1
48-72 hours	6	16
>72 hours	1	8

Vomiting, abdominal pain and bloody stool remains the predominant symptoms in most of the children. But these classical triad were present only in 20% children. Vomiting (90%)

remains the most common symptom. Six children (12%) presents directly with features suggestive of peritonitis like guarding and generalized abdominal tenderness.

Table 3: Clinical profile

Clinical presentation	No. of patients	Percentage (%)
Vomiting	45	90
Abdominal pain	38	76
'Red currant jelly'-bloody stool	16	32
Abdominal mass	20	40
Constipation	10	20
Diarrhoea	23	46
Irritability	25	50
Signs of peritonitis	6	12

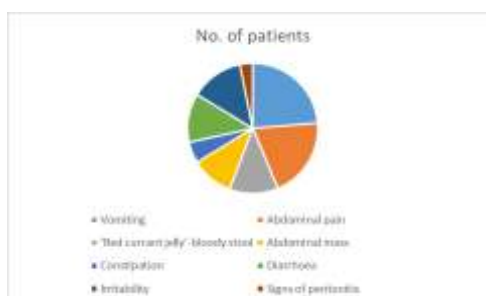


Image 1: Pie-chart showing the symptoms

All the diagnosed patients are considered for non-operative trial with pneumatic reduction unless there are obvious signs of peritonitis or shock. Twenty five patients (50%) were successfully managed with pneumatic reduction

and nine (18%) others were initially approached with pneumatic reduction, but upon failure to reduce in third attempt or development of colonic perforation, were converted to laparotomy.

Table 4: Operative procedures

Procedures	Numbers (N)	Percentage (%)
Pneumatic reduction	25	50
Definitive Laparotomy	16	32
Converted to laparotomy	9	18

In our observation, most of the cases (84%) turned out to be Ileo-colic intussusception which in most of the cases (72%) were idiopathic

in etiology. Other lead points causing the formation of intussusception were appendix (8%) and enlarged mesenteric lymph nodes (6%).



Table 5: Intra-operative findings

Intra-operative finding	Number (N)	Percentage (%)
1. Ileo-colic intussusception	42	84
i. Idiopathic	36	72
ii. Appendix	4	8
iii. Enlarged lymph nodes	2	4
2. Ileo-ileal intussusception	8	16
i. Idiopathic	7	14
ii. Enlarged lymph nodes	1	2

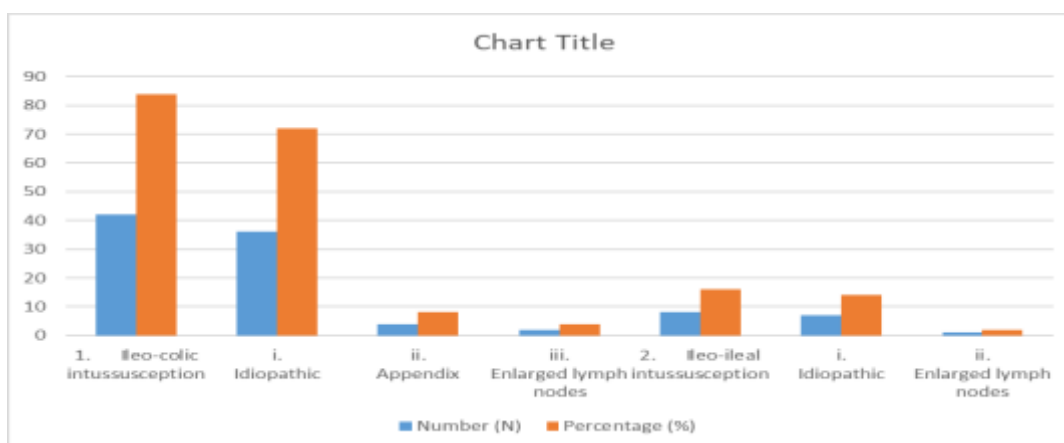


Image 2: Bar chart showing the etiological factors

Most of the post-operative events shows in favour of pneumatic reduction in terms of duration of hospital stay, duration for which the patient has to remain nil per oral (NPO) and also possibility of developing surgical site infection which we experienced in laparotomy patients in 20% cases.

However, we face the grim possibility of recurrence of intussusception formation as presence of lead points cannot be tackled during non-operative management, which we have seen in 3 cases (6%).

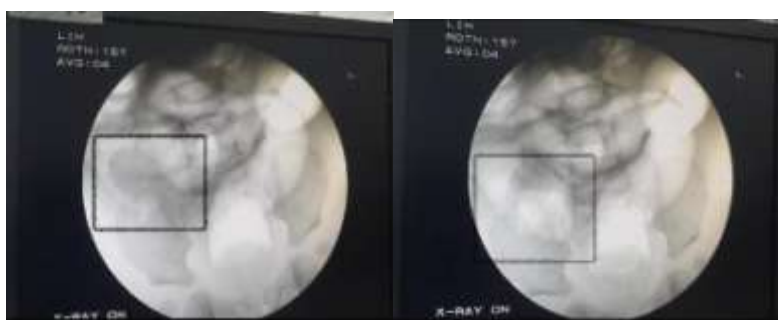


Image 3: Image showing bowel inside bowel Image 4: Release of Intussusceptum

Table 6: Post-operative events

Post-operative events	Pneumatic reduction	Laparotomy
Hospital stay duration	2-3 days	8-9 days
Duration of Nil per oral	1-2 days	5-6 days
Prolonged intravenous management	1-2 days	5-7 days
Surgical site infection	None	5 cases
Recurrence	3 cases	None



V. DISCUSSION:

Intussusception is a true paediatric surgical emergency with considerable morbidity and mortality if not treated promptly. It is one of the most common cause of an acute abdominal emergency in children. Therefore, timely diagnosis and prompt treatment is highly recommended. Early diagnosis as well as early presentation decreases the chances of surgical exploration as well as mortality in the patients.

At present, non-surgical reduction is the primary treatment for paediatric intussusception. Pneumatic reduction is the globally accepted management for intussusception due to its ease of performance, high success rate and cost effectiveness.[17]

In our study most of the cases presented in the age group of 1 to 3 years age group (28%). 18% of the cases were above 5 years of age.

The classical triad of intermittent abdominal pain, red currant jelly stool, and a palpable abdominal mass were seen in only 20% of the cases, which is similarly quoted by Macdonald I et al and McDermott VG et al.[15,16] In our study, 38 out of 50 children presented with complains of abdominal pain (76%), 16(32%) presented with the classic red currant jelly stools, and 20 (40%) presented with palpable mass per abdomen. Many children present with non-specific signs and symptoms. In our study most common symptoms was vomiting in 90% which is similarly quoted by DiFiore JW et al and Losek JD et al.[18,19] Other symptoms include constipation in 20%, diarrhoea in 46% and 12% of the patients presented with signs of perforation peritonitis. Farhan tareen et al reported similar findings with abdominal pain in 77%, abdominal mass in 50% and bleeding per rectum in 36% of the cases.[20]

Of all the three cardinal signs, palpable mass per abdomen is the most reliable. It was present in 20% of our patients. Although, the presence of a palpable abdominal mass is a risk factor for failure of non-operative reduction as it may suggest a longer duration, complete bowel obstruction with a setting of ischemia.[21,22]

Early presentation and prompt diagnosis play a major role in the success of pneumatic reduction.[11,16] We can conclude that a high index of suspicion and keeping in mind the variable presenting symptoms can aid in early diagnosis. In our study, all the patients presenting within a duration of twenty four hours underwent successful pneumatic reduction. However, as the duration of presentation increased so did the number of patients who required surgical treatment.

In our study the mean duration of symptoms before presentation was 39.84 hrs. Only 7(14%) patients presented within 24 hrs. This is comparable to other studies conducted by Joda AE et al. [21] The patients presenting late (>48 hrs) shows propensity of developing complications.[23] The major factor behind this might be ignorance, poverty and poor access to health care facilities.

Ileo-colic intussusception is the most common type found in our study as described by various other studies.[2,20] The 'Lead-point' in most of the cases turned out to be Idiopathic which is also in consistent with various other studies.[2,20,24]

Pneumatic reduction has the advantage of lesser duration of hospital stay which can be seen in our study with an average of 1-3 days as compared to 5-12 days in cases of surgical management. Most of the patients undergoing laparotomy shows bowel ischaemia intra-operatively and in 6(12) patients had to undergo resection-anastomosis. Such patients had to be kept nil per oral and on intravenous management till the bowel regains its normal function. 5(10%) cases develops surgical site infection for which the stay at hospital was prolonged until a secondary suturing could be done. Such complications are seen in patients who presented beyond 48 hours of initial presentation of symptoms. [23] Recurrence of intussusception in patients undergoing pneumatic reduction remains a big challenge. It was seen in 3(6%) patients- one patient within 6 hours, another within 5 days and third case on 8th day post-operatively. The rate of recurrence was quite low as compared with other studies.[25-28]

One drawback in our study is use of C-arm Fluoroscopy imaging. Ionizing radiation can cause both somatic and genetic damage [29] especially in children who are two to five times more sensitive than adults [30].Duration of C-arm exposure in our study was around 15 to 18 mins.Screening time of 30min has been estimated to produce a risk of one in 1000 for the development of radiation-induced cancer. [31] In a randomised trial performed by Hadidi and El Shal, pneumatic reduction was concluded to be the modality with fewest complications and highest success rate, when compared with barium enema and hydrostatic reduction.[14]

VI. CONCLUSION:

From our study we have observed that Pneumatic reduction is a highly viable option as a non-operative management for treatment of Intussusception, with a relatively high success rate and low complication rate. Decision of operative



management should never be delayed in those presenting beyond 48 hours, signs of bowel ischemia, peritonitis or shock.

REFERENCES:

- [1]. Fischer TK, Bihrmann K, Perch M, Koch A, Wohlfahrt J, Ka^ore M, et al. Intussusception in early childhood: a cohort study of 1.7 million children. *Pediatrics* 2004; 114:782–785.
- [2]. Bajaj L, Roback MG. Postreduction management of intussusception in a children's hospital emergency department. *Pediatrics* 2003;112:1302-7.
- [3]. Bines J, Ivanoff B. Acute intussusception in infants and children: incidence, clinical presentation and management: a global perspective. Report 02.19. Geneva: World Health Organization; 2002.
- [4]. Swischuk LE, Hayden CK, Boulden T. Intussusception: indications for ultrasonography and an explanation for the doughnut and pseudokidney signs. *PediatrRadiol* 1985; 15:388–391.
- [5]. del-Pozo G, Albillos JC, Tejedor D. Intussusception: US findings with pathologic correlation the crescent-in-doughnut sign. *Radiology* 1996; 199:688–692.
- [6]. Frush DP, Zheng JY, McDermott VG, Bisset GS III. Nonoperative treatment of intussusception: historical perspective. *AJR Am J Roentgenol* 1995; 165:1066–1070.
- [7]. McAlister WH. Intussusception: even Hippocrates did not standardize his technique of enema reduction. *Radiology* 1998; 206:595–598.
- [8]. Guo JZ, Ma XY, Zhou QH. Results of air pressure enema for the reduction of intussusception: 6,396 cases in 13 years. *J PediatrSurg* 1986; 21:1201–1203.
- [9]. Kirks DR. Air intussusception reduction: the winds of change. *PediatrRadiol* 1995; 25:89–91.
- [10]. Shiels WE II, Maves DK, Hedlund GL, Kirks DR. Air enema for diagnosis and reduction of intussusception: clinical experience and pressure correlates. *Radiology* 1991; 181:169–172.
- [11]. Stein M, Alton DJ, Daneman A. Pneumatic reduction of intussusception: 5-year experience. *Radiology* 1992; 183:681–684.
- [12]. Lui KW, Wong HF, Cheung YC, et al. Air enema for diagnosis and reduction of intussusception in children: clinical experience and fluoroscopy time correlation. *J PediatrSurg* 2001;36:479-81.
- [13]. Rubí I, Vera R, Rubí SC, et al. Air reduction of intussusception. *Eur J PediatrSurg* 2002;12:387-90.
- [14]. Hadidi AT, El Shal N. Childhood intussusception: a comparative study of nonsurgical management. *J PediatrSurg* 1999;34:304-7.
- [15]. Macdonald I, Beattie T (1995) Intussusception presenting to a paediatric accident and emergency department. *J AccidEmerg Med* 12:182–186
- [16]. McDermott VG, Taylor T, Mackenzie S, Hendry GMA (2009). Pneumatic reduction of intussusception: clinical experience and factors affecting outcome. *ClinRadiol* 64(7):655–663
- [17]. Peh WC, Khong PL, Lam C, et al. Reduction of intussusception in children using sonographic guidance. *AJR Am J Roentgenol* 1999;173:985-8.
- [18]. DiFiore JW. Intussusception. *Semin Pediatr Surg* 1999;8:214-20.
- [19]. Losek JD. Intussusception: don't miss the diagnosis! *PediatrEmerg Care* 1993;9:46-51.
- [20]. Farhan Tareen • Stephanie Ryan • Stefano Avanzini • Victor Pena • Danielle Mc Laughlin • PremPuri et al (2011) Does the length of the history influence the outcome of pneumatic reduction of intussusception in children? *PediatrSurgInt* (2011) 27:587–589.
- [21]. Joda AE, Salih WM, Shakarlay NH. Ultrasound guided pneumatic reduction of intussusception: A clinical experience from Baghdad. *Am J Paediatr.* 2017;3:76-82.
- [22]. Carol WY Wong, Ivy HY Chan, Patrick HY Chung, Lawrence CL Lan, Wendy WM Lam, Kenneth KY Wong, Paul KH Tam et al. Childhood intussusception: 17-year experience at a tertiary referral centre in Hong Kong. *Hong Kong Med J* 2015;21:518–23.
- [23]. Shapkina AN, Shapkin VV, Nelubov IV, Pryanishena LT (2006) Intussusception in children: 11-year experience in Vladivostok. *PediatrSurgInt* 22(11):901–904.
- [24]. Raes RA, Hyde I, Griffiths DM (1988) The management of intussusception. *The British Journal of Radiology*, 61, 187—189.



- [25]. Champoux AN, Del Beccaro MA, Nazar-Stewart V (1994) Recurrent intussusceptions: risks and features. *Arch PediatrAdolesc Med* 148:474-478.
- [26]. Fecteau A, Flageole H, Nguyen LT, Laberge J-M, Shaw KS, Guttman FM (1996) Recurrent intussusception: Safe use of hydrostatic enema. *J PediatrSurg* 31(6):859-861.
- [27]. Daneman A, Navarro O (2004) Intussusception. Part 2: an update on the evolution of management. *PediatrRadiol* 34:97-108.
- [28]. Ko HS, Schenk JP, Troger J, Rohrschneider WK (2007) Current radiological management of intussusception in children. *EurRadiol* 17(9):2411-2421.
- [29]. CheolHee Jung, Jae Sung Ryu, Seung Woo baek, Ji Hye Oh, Nam Sik Woo, HaeKyoungkim, Jae Hun Kim et al. *Korean J Pain*. 2013;26(1):51-56.
- [30]. Frush DP, Applegate KE. Radiation risk from medical imaging in children. In: Medina LS, Applegate KE, Blackmore CC, editors. *Evidence-based imaging in pediatrics: improving the quality of imaging in patient care*. 1st ed. New York: Springer; p. 25.
- [31]. Heenan SD, Kyriou J, Fitzgerald M, Adam EJ. Effective dose at pneumatic reduction of paediatric intussusception. *ClinRadiol* 2000; 55:811-816.