The Effect of Preoperative Dexamethasone on increasing the Success Rate of Intussusception Pneumatic Reduction in Pediatrics

Original Article

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ABSTRACT

Background: Intussusception is a common cause of intestinal obstruction during infancy and childhood. Treatment in early cases is non-surgical including hydrostatic or pneumatic reduction, adjuvant corticosteroids can be added to increase the success rate of non-surgical management. Dexamethasone is a long rapidly acting corticosteroid, in this study we aim to evaluate its efficacy in its high and low doses to minimize the need for surgical treatment.

Methods: A prospective controlled clinical trial conducted on patients divided into three groups, group (A) received low dose of dexamethasone, group (B) was subjected to high dose dexamethasone and group (C) received normal saline. Patients presenting with early symptoms were selected. Patients were subjected to 3 trials of pneumatic reduction if the first and second trials were unsuccessfull. Dexamethasone was given once before first trial only.

Results: The study involved 101 patients from January 2023 to December 2023, 34 patients in group (A), 34 patients in group (B) and 33 patients in group (C). Across all trials, a total of 70 patients (69.3%) achieved success; 82.4% of group A, 88.2% of group B, achieved success and 36.4% of group C. 64 out of 70 patients (91.4%) were successfull from the first trial. We found a statistically significant increase in success rate among groups taking dexamethasone either in low or high doses and the group taking saline with no significant difference compaing low with high dose dexamethasone.

Conclusion: The use of dexamethasone before pneumatic reduction of intussusception is effective in avoiding surgical management, more studies should be conducted to be used before every trial.

Key Words: Dexamethasone, intussusception intestinal obstruction , pneumatic reduction.

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INTRODUCTION

Intussusception is a common cause of bowel obstruction in infants and young children, with an incidence of 74 per 10,000 worldwide in the first year of age [1]. It involves one segment invaginating the intestine into a distal segment, causing venous and lymphatic congestion, bowel edema, and ultimately ischemia and perforation[2]. Ileocolic intussusceptions are the most common site of pediatric intussusceptions. Primary intussusceptions occur without a leading point due to hypertrophied Peyer's patches[3], while secondary intussusceptions have a defined leading point due to various causes[4]. The main causes of secondary intussusception are meckel's diverticulum, duplication of the bowel, polyps, ectopic pancreatic tissue, and other systemic diseases such as cystic fibrosis[5].

Symptoms most commonly are abdominal pain, vomiting, red currant jelly stool, pallor, and lethargy[6]. Diagnosis is based on the Brighton Collaboration intussusception working group criteria[7].

Regarding treatment, it includes non-surgical and surgical procedures, with hydrostatic and pneumatic methods being the most common non-surgical reduction methods[8-10]. Air enemas are more effective than hydrostatic enemas[8]. Under fluoroscopy or ultrasonography, the colon is compressed while being monitored for air reflux into the terminal ileum and the disappearance of the mass at the ileocecal valve. Carbon dioxide can replace air[11].

The appropriate time interval between enemas varies between 30 minutes and several hours, depending on the situation. Delayed repeat enemas have significantly decreased the need for surgical intervention[10].

Non-operative treatment for intussusception is preferred due to lower morbidity and cost. It is recommended to

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perform a repeat enema in all cases unless there is a specific reason not to do so. If the second enema is successful, it may be reasonable to attempt the procedure for a third or fourth time. However, in cases where surgery is needed and intussusception is already reduced, the question arises as to whether the case would have been manageable with a delayed repeat enema and surgery could have been avoided[10].

The duration of symptoms significantly impacts the success rate of enema reduction, with longer symptoms beyond 24 hours reducing the likelihood of successful contrast enema reduction. Delays in treatment are typically 48 hours, but some suggest as little as 24 or 72 hours[12]. Non-surgical reduction failures range from 46% to 94% and can be caused by factors such as duration of symptoms, emesis, bloody stool, and poor ultrasound prognosis signs[13]. Lower enema reduction rates are linked to other factors such as age, dehydration, small bowel obstruction, and rectum intussusception[10].

Cortisol has potent anti-inflammatory effects and can stabilize lysozyme membranes and decrease capillary permeability, which prevents the loss of plasma protein into tissues[14]. Dexamethasone, a synthetic glucocorticoid, has been used to treat asthma, allergic reactions, arthritis, and autoimmune diseases and acts through the Blockade of two pathways of inflammation; vasodilation and immune cell migration[15]

Thus, this study aims to evaluate the efficacy of dexamethasone in its high and low doses to minimize the need for surgical treatment. Notably, this research addresses a gap in existing literature by Being the first to investigate the role of dexamethasone in the context of pneumatic reduction for idiopathic intussusception.

PATIENTS AND METHODS:

This is an experimental randomized control trial done on 101 children suffering intussusception coming to the Cairo university specialized pediatric hospital from June 2022 to November 2023. Our study population included patients presented with intussusception, age ranging only from 3 months to 3 years and onset of symptoms less than 72 hours. We also excluded those who have signs of severe shock or suspected bowel ischemia.

Methodology in details:

Data were collected for all patients regarding, number of trials of pneumatic reduction, success of pneumatic reduction, need for laparotomy, ease of simple reduction, incidence of complications and all patients given antibiotics.

Patients were subjected to detailed history taking and clinical examination. Pre-operative laboratory investigations including a complete blood count, coagulation profile, electrolyte, urea and creatinine and arterial blood gases were done as well as radiological investigations including abdominal ultrasound to confirm the diagnosis and detect site and vascularity as well as any free peritoneal fluid and pathological lead point if present. Abdominal x-ray was done to detect intestinal obstruction or perforation. Preoperative preparation included correction of dehydration, shock and electrolyte disturbance and nasogastric tube insertion.

The subjects were subdivided into three groups:

Group A: including 34 patients receiving dexamethasone at low dose 0.5 mg per kg.

Group B: including 34 receiving dexamethasone at high dose 2 mg per g. The dexamethasone is given one hour before the process of pneumatic reduction and could be repeated before every trial with one hour interval.

Group C: including 33 patients given normal saline.

Pneumatic reduction was done through the following steps:

- Child placed in supine position, near edge of table.
- Foley catheter size 20 fr inserted to anus.
- Balloon insufflated by 35 ml air.
- Pneumatic pressure trial at a pressure 80-120mmhg maximum.
- Trial 3 times with one hour interval between every trial.

Successful reduction:

All bowel loops come out of each other, mass released, colon and small intestine filled with air under fluoroscopy. In query cases ultrasound is used to confirm success of pneumatic reduction.

Failure of pneumatic reduction necessitated resining to operative procedures either through laparoscopic technique or open surgical technique.

Post-operative care:

Nasogastric tube was kept until signs bowel was open. Amoxicillin, metronidazole and gentamycin was given, paracetamol and ibuprofen were given for pain.

Patients were discharged after reaching full feeds and normal bowel motions, with recommendations to parents to follow up the recurrence of warning symptoms of intussusception again and oral metronidazole to continue 10 days and paracetamol. Follow up was done at Aboelreesh specialized paediatric hospital outpatient clinic.

Statistical methods:

Collected data was entered and coded on Microsoft Excel 2016®, then analyzed using ICM® SPSS v25. Chi-squared or Fisher's exact tests were used to compare qualitative variables between the 3 groups. The conformity of the distribution of the studied variables to the normal distribution was checked (Shapiro-Wilk test). Based on the results obtained, a decision was made to use the appropriate statistical test. Either independent-t test or Mann Whitney U test was used to detect statistically- significant difference between 3 groups for quantitative variables. Data was presented in tables and graphs.

RESULTS

Our study included 101 children suffering intussusception matching our inclusion criteria coming to the Cairo University Specialized Pediatric Hospital. The patients were divided into 3 groups: group A (34 patients) receiving low dose dexamethasone, group B (34 patients) receiving high dose dexamethasone and group C (33 patients) receiving normal saline. Regarding sex distribution, 69 (68.3 %) patients were males and 32 (31.7%) were females, with male to female ratio 2.2 to 1. The males were predominant through the 3 study groups representing 73%, 62%, and 71% of groups A, B and C respectively. Thes ages of study participants had a mean of 0.9, 1, 0.9 years for groups A, B and C respectively. Weights had an average of 8.7 kg for group A, 9 kg for group B and 9.3 kg for group C.

In study group A, out of a total of 34 cases, 24 patients (70.6%) experienced early symptoms such as abdominal pain, vomiting, colics, and abdominal distention. Additionally, 10 cases (29.4%) had red currant jelly stool. Similarly, in group B, out of 34 cases, 24 patients (70.5%) had the same early symptoms. Among them, 10 cases (29.4%) had red currant jelly stool. In group C, there were a total of 33 cases, out of which 22 patients (66.6%) experienced early symptoms. Additionally, 11 cases (29.4%) of group C had red currant jelly stool. A mass was felt during examination in more than 75% of patients in each 3 study groups (Table 1).

Table (1) : Pre-operative clinical picture of intussusception cases in our study.

Presenting Symptoms	Group A (low dose) (N= 34) N (%)	Group B (high dose) (N= 34) N (%)	Group C (normal saline) (N= 33) N (%)
Red currant jelly stool (late)	10(29.4)	10(29.4)	11(33.3)
Abdominal pain and colics (early)	22(64.7)	23(67.6)	18(54.5)
Abdominal distension (early)	2(5.9)	1(2.9)	4(12.1)
Mass felt during examination	25(75.8)	27(79.4)	27(79.4)

Out of all the trials, a total of 70 patients achieved complete success with pneumatic reduction, 64 patients were successfully reduced in the first trial, 4 patients in the second trial, 2 patients in the third trial. In group A, 28 patients (82.4%) were successful. In each of the groups A and B, more than 80% of patients achieved success. However, in group C, only 36.4% were successful. There was a statistically significant increase in success rate among both groups taking dexamethasone across all trials (*P-value* <0.001).

In group A, B and C, 26, 27 and 11 patients achieved successes from the first trial respectively showing a statistically significant difference between these groups (P-value <0.001). In the second trial, success was observed in 2 patients from group A, 2 patients from group B, and none of the patients from group C and these results were significant as well showing a P-value of 0.021. None of the patients from group A, 1 from group B, and 1 from group C all had success in the third trial; however, there were no significant differences regarding the third trial's success rate between the groups (P-value= 0.331) (Table 2) (Fig. 1 & 2).

Table (2) : Pneumatic reduction success after each trial and total success among all study groups

Pneumatic reduction success		Group A (low dose)	Group B (high dose)	Group C (normal saline)	Total	P-value
1st trial						
No	Number	8	7	22	37	
	%	23.5%	20.6%	66.7%	36.6%	
Yes	Number	26	27	11	64	<0.001
	%	76.5%	79.4%	33.3%	63.4%	
Total	Number	34	34	33	101	
	%	100.0%	100.0%	100.0%	100.0%	
2nd trial						
No	Number	6	5	22	33	
	%	75%	71.4%	100.0%	89.2%	
Yes	Number	2	2	0	4	0.021*
	%	25%	28.6%	0.0%	10.8%	
Total	Number	8	7	22	37	
	%	100.0%	100.0%	100.0%	100.0%	
3rd trial						
No	Number	6	4	21	31	
	%	100.0%	80.0%	95.5%	93.9%	
Yes	Number	0	1	1	2	0.313*
	%	0.0%	20.0%	4.5%	6.1%	
Total	Number	6	5	22	33	
	%	100.0%	100.0%	100.0%	100.0%	
Total success						
No	Number	6	4	21	31	
	%	17.6%	11.8%	63.6%	30.7%	
Yes	Number	28	30	12	70	<0.001*
	%	82.4%	88.2%	36.4%	69.3%	
Total	Number	34	34	33	101	
	%	100.0%	100.0%	100.0%	100.0%	

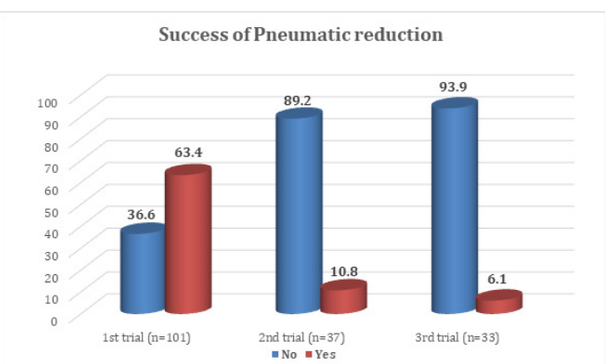
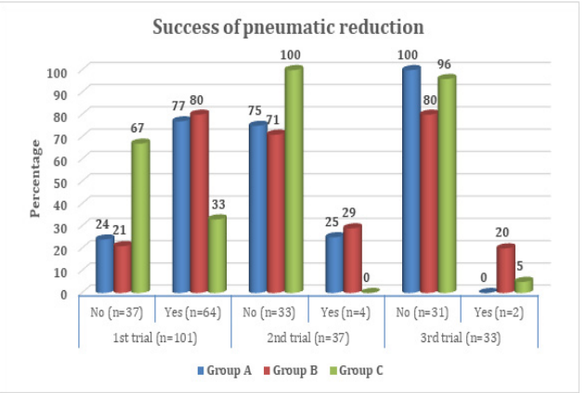


Fig. (1) : Success of reduction after different trials across all groups

Fig. 2 Success rate of pneumatic reduction in the 3 trials among the 3 study groups



Comparing patients receiving dexamethasone at any dose and those receiving saline, there was a statistically significance difference between results of total success of reduction and at 1st and 2nd trials (P-value <0.05); however, there was no statistically significant difference between dexamethasone receiving patients and those receiving saline on the 3rd trial (P-value>0.999) (Table 3).

Table (3) : Pneumatic reduction success after each trial and total success among dexamethasone and saline groups

Pneumatic reduction success		Dexamethasone (Groups A+B)	Saline (Group C)	Total	P-value
1st trial					
No	Number	15	22	37	<0.001
	%	22.1%	66.7%	36.6%	
Yes	Number	53	11	64	
	%	77.9%	33.3%	63.4%	
Total	Number	68	33	101	
	%	100.0%	100.0%	100.0%	
2nd trial					
No	Number	11	22	33	0.021*
	%	73.3%	100.0%	89.2%	
Yes	Number	4	0	4	
	%	26.7%	0.0%	10.8%	
Total	Number	15	22	37	
	%	100.0%	100.0%	100.0%	
3rd trial					
No	Number	10	21	31	>0.999*
	%	90.9%	95.5%	93.9%	
Yes	Number	1	1	2	
	%	9.1%	4.5%	6.1%	
Total	Number	11	22	33	
	%	100.0%	100.0%	100.0%	
Total success					
No	Number	10	21	31	<0.001
	%	14.7%	63.6%	30.7%	
Yes	Number	58	12	70	
	%	85.3%	36.4%	69.3%	
Total	Number	68	33	101	
	%	100.0%	100.0%	100.0%	

* Fisher's exact test

the third. The total success of pneumatic reduction in group A was 82.4% compared to group B which was 88.2%, and there is no statistically significant difference between the group taking small dose and the one taking high dose as the P-value is 0.49 (Table 4).

Table (4) : Pneumatic reduction success after each trial and total success among the 2 dexamethasone groups

Pneumatic reduction Success		Group A (low dose)	Group B (high dose)	Total	P-value
1st trial					
No	Number	8	7	15	0.770
	%	23.5%	20.6%	22.1%	
Yes	Number	26	27	53	
	%	76.5%	79.4%	77.9%	
Total	Number	34	34	68	
	%	100.0%	100.0%	100.0%	
2nd trial					
No	Number	6	5	11	>0.999*
	%	75%	71.4%	73.3%	
Yes	Number	2	2	4	
	%	25%	28.6%	26.7%	
Total	Number	8	7	15	
	%	100.0%	100.0%	100.0%	
3rd trial					
No	Number	6	4	10	0.455*
	%	100.0%	80.0%	90.9%	
Yes	Number	0	1	1	
	%	0.0%	20.0%	9.1%	
Total	Number	6	5	11	
	%	100.0%	100.0%	100.0%	
Total success					
No	Number	6	4	10	0.493
	%	17.6%	11.8%	14.7%	
Yes	Number	28	30	58	
	%	82.4%	88.2%	85.3%	
Total	Number	34	34	68	
	%	100.0%	100.0%	100.0%	

*Fisher's exact test

Thirty-one patients needed surgical intervention after failed 3 trials of pneumatic reduction. The number of patients who needed surgical intervention was 6 in group A, 4 patients in group B, and 21 patients in group C which means that only 15% of the groups receiving dexamethasone versus 67% of the saline group needed surgery.

In group A, out of the 6 patients who needed surgical intervention, half (3 patients) underwent laparoscopic assisted simple reduction, 1 (16.7%) patient needed laparoscopic to open surgery simple reduction, 1 (16.7%) patient needed open simple reduction and resection anastomosis in 1 patient (16.7%) had gangrenous, non-viable bowel.

In group B, 4 patients needed surgical intervention divided into laparoscopic assisted simple reduction in 1 patient (25%), open simple reduction in 2 patients (50%) and resection anastomosis in 1 patient (25%) that had gangrenous, non-viable bowel.

In group C, a larger number of patients needed surgical intervention (21 patients) divided into laparoscopic assisted simple reduction in 7 patients (33.3%), laparoscopic to open simple reduction in 1 patient (4.8%), open simple reduction in 8 patient (38.1%) and resection anastomosis in 5 patients (23.8%) that had gangrenous, non-viable bowel (Fig. 3).

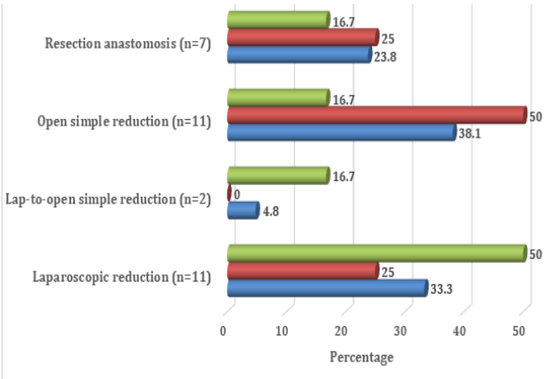


Fig.(3): Types of surgical intervention among study groups

As regards post-surgical complications, there was only 1 case (received high dose of dexamethasone) suffered from pneumo-peritoneum.

The conditions of the bowel in cases that needed laparotomy were viable in 20 patients, 6 in group A (low dose), 2 patients in group B (high dose), and 12 in group C (saline). The bowel was not viable in 9 patients that needed resection anastomosis of the bowel, 7 of which were in group C (saline).

DISCUSSION

This study is conducted to evaluate the role of dexamethasone in achieving success for pneumatic reduction of pediatric intussusception in comparison to pneumatic reduction without dexamethasone. Many investigators made studies on intussusception in children, Kumar et al. conducted a study on 207 children aged less than 5 years admitted in the 8 study hospitals in Chennai diagnosed to have intussusception [16]. Apelt et al. evaluated ten retrospective studies treating 276 cases of laparoscopically reduced intussusception [17]. To our knowledge, this study is a novel work as there are no other published studies in literature studying the impact of dexamethasone on the success rate of pneumatic reduction for idiopathic intussusception.

The rationale behind this study is that the use of steroids can reduce tissue edema and decrease the thickness of the bowel wall, thereby facilitating the process of pneumatic reduction in intussusception[15].

After suspicion of intussusception diagnosis, only stable cases with no resisting shock, peritonitis or pneumoperitoneum were subjected to this study. A decision is made whether the patient needs surgical intervention or not.

Dexamethasone was chosen as it is a potent, rapid, and long-acting steroid. It acts through the Blockade of two pathways of inflammation; vasodilation and immune cell migration. Dexamethasone crosses the host cell membrane and binds to glucocorticoid receptors present in the cell cytoplasm, which initiates a series of immune cell responses that lead to pro-inflammatory suppression cytokines IL-1, IL-2, IL-6, IL-8, TNF, and IFN-γ through a decrease in gene transcription[18]. It was given with resuscitation before starting pneumatic reduction by 1to 3 hours in one group of patients (group A) in low dose 0.5 mg per kg per dose, while the second group (group B) is given dexamethasone in high dose 2mg per kg per dose. In comparison to the third (group C) that takes saline as placebo.

We found in the current study conducted on 101 patients with male to female ratio 2.2:1. Other studies found the same results, such as a study by Kumar et al. in 2016 on 207 children aged less than 5 years old in Chennai diagnosed with intussusception having the males more than females with a ratio 1.8:1 [16], also Gfroerer et al. included 38 patients in their study and found male to female to be 2:1.[19].

In this study, most cases were presented with early symptoms of abdominal pain, colics and vomiting. Pediatric cases in the study by Ntoulia et al., including 543 patients, presented with primary intussusception, suffered the same symptoms as our study population with or without palpable abdominal mass. Symptoms of feeding intolerance, irritability, or lethargy were less frequently reported[20].

Pneumatic reduction of intussusceptions gained popularity in the 1980s being safe, fast, and effective[21]. In our study, pneumatic reduction significantly reduced the need for surgical intervention. Pneumatic reduction has shown a success rate of 69.5%. Similarly, another study involving 32451 children found that air enema reduction for intussusception had a higher success rate compared to liquid enema reduction (82.7% for air enema and 69.6% for liquid enema)[8,9].

The results showed that hydrocortisone (dexamethasone) had increased the success rate of pneumatic reduction from 36.4% in the saline group to 85.3% in the hydrocortisone groups. They also showed that successful reduction from the first trial had been increased and even doubled as it was 33% in the saline group and increased to 78% in the hydrocortisone group.

The success of the use of dexamethasone was also evident in the decreased need for laparotomy by the dexamethasone groups compared to the saline placebo group (67% in the saline group compared to just 15% in the dexamethasone groups). Also, the easy simple reduction was decreased from 72% to 28% with use of dexamethasone.

In the third trial, the success rate was observed to be 1 patient in group B, 1 patient in group C, and no patients in group A. The need for a delayed repeat enema in the third trial did not show significant differences between the

groups. It's important to note that dexamethasone was not administered repeatedly with each trial in group A, but rather given only once during the initial resuscitation.

Also, it is worth noting that after evaluation of the results from the two groups which were administered dexamethasone, we found no difference in the success rate of pneumatic reduction between them suggesting that dexamethasone can be given in high or low doses to achieve successful pneumatic reduction.

No complications from the use of hydrocortisone had been encountered during the study in the form of hypertension, electrolyte imbalance or wound healing as all cases were monitored in an intermediate care unit from the moment of admission until they improved and started oral feeding. Blood pressure was monitored before resuscitation to detect the degree of hemodynamic stability and monitoring was continued during resuscitation and after intervention with pneumatic reduction or surgical interference.

Complete blood picture, coagulation profile and electrolytes were also asked before any intervention, and no difference was noticed between study groups in the post intervention period.

Cases that needed laparotomy for simple reduction or resection anastomosis in both groups were followed up and the use of hydrocortisone did not show that it increase the complication rate regarding healing.

CONCLUSION:

This study establishes the efficacy of dexamethasone in enhancing the success of pneumatic reduction for pediatric intussusception. The decreased need for surgical intervention, along with a notable reduction in the instances of simple reduction, emphasizes the potential of dexamethasone in optimizing the non-operative management of intussusception in children.

CONFLICT OF INTEREST:

Authors declare no conflict of interest is present.

ETHICAL CONIDERATION:

Ethical approval was obtained from the institutional review board at the armed forces college of medicine. A written informed consent was obtained after proper orientation for study subjects regarding the objectives of the study. Participation was voluntary, only those who agreed were included and the participant may discontinue participation at any time. Strict confidentiality and privacy were maintained throughout the process of data collection, entry and analysis as declaration of Helsinki.

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