Seasonal variations and different treatment protocols of intussusception in children: our center experience

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Background
Intussusception remains a common cause of bowel obstruction in children and results in significant morbidity and mortality if not promptly treated. There is a paucity of prospective studies regarding childhood intussusception. This study describes the seasonal variation and management outcomes of childhood intussusception.
Methods
This was a prospective study of all patients aged less than 12 years admitted and treated for childhood intussusception from January 2014 to December 2018 conducted in El-Minia University Pediatric Surgery Unit. Data about the ages of the patients, sex, clinical presentation, duration of symptoms before presentation, mode of treatment, outcome of treatment, and incidence of recurrence were recorded and analyzed.
Results
A total of 470 patients were studied. The male to female ratio was 2.3 : 1. The median age was 6 months. In all, 82.3% of patients were less than 1 year. Etiology was mainly idiopathic in 95.1% of cases. The classic triad of bloody stool, vomiting, and abdominal distention/abdominal colic was found in (58%) of patients. The diagnosis of intussusception was by clinical examination and ultrasonography in all cases. Treatment was either pneumatic reduction or operative.
Conclusion
Intussception is the most common cause of intestinal obstruction in infants and toddlers mostly aged below 1 year, so the authors recommend increasing the knowledge about intussusception among physicians and parents especially in the first year of life and in spring.

Keywords:
intussusception, pediatric surgery, pneumoreduction, season variation

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Introduction

Intussusception is the invagination of a segment of bowel into an adjacent segment resulting into an intestinal obstruction. It is the most common acquired cause of intestinal obstruction in children aged 4 months to 2 years with a peak of incidence between 4 and 9 months of age [1]. Etiology of intussusception is reported to be idiopathic in about 90% of cases and rarely is it associated with pathological lead points such as Meckel's diverticulum, appendix, solid bowel lesions, intestinal polyp, and intestinal lymphoma [2]. It is an occlusive-strangulation type of intestinal obstruction, and all necessary measures should be taken early to ensure prompt diagnosis and treatment to avoid ischaemia and necrosis of bowel [3]. The term comes from two Latin words, intus, which means "inside" and suscipere, which means "to receive." It has been reported in neonates and adults [4]. The ancient Greeks treated intestinal obstruction with enema or insufflations of air into the anus [5]. Abdominal pain, vomiting, and blood in stools are the classic triad and are uncommon and seen in less than one-third of the affected children [6]. Cases often present with nonspecific symptoms, including vomiting, pain, irritability, decreased appetite, and lethargy, and this may render diagnosis of intussusception difficult [7]. Abdominal ultrasound is considered the standard choice for its diagnosis. Nonsurgical management with pneumatic reduction (PR) by air, hydrostatic reduction by saline, or contrast enema is the best procedure [8]. Surgical management by exploratory laparotomy with simple reduction can be performed, whereas some cases may require a bowel resection and reanastomosis for gangrenous bowel [9].

The aim of our study is to evaluate the peak of months recorded to have cases with intussusception in two pediatric surgery centers across Egypt. Also, we aim

to evaluate the different modes of management of intussusception used in our centers.

Patients and methods

A prospective study from January 2014 to December 2018 was conducted in 470 cases in El-Minia University Pediatric Surgery Unit.

Inclusion criteria were as follows: all pediatric patients (up to 14 years old) diagnosed clinically and by ultrasound as bowel intussusception, age, sex, signs, symptoms, and number of any previous episodes of intussusception and their management, ultrasound data, laboratory parameters, and performed treatment.

Exclusion criteria were all patients with previously abdominal surgical intervention, concomitant pathologies and intolerance, or if parents refused to share in the study.

An ultrasonography was performed when patients presented suspicion symptoms and signs of intussusception, to confirm the diagnosis and exclude other causes. Diagnosis was based on the presence of the "target sign" on vertical section on ultrasound images. Collected data included location and diameter of the intussusception, free fluid in abdomen, and presence of visible pathological lead point. If diagnosis was confirmed, the management and treatment depended on the patients' situation. If patients complain about severe dehydration, high grade fever, and other signs of septicemia, the conservative treatment was contraindicated and direct surgical treatment was performed. For children in good general conditions, initial PR under continuous imaging monitoring using a C-arm device was attempted; if reduction failed or unstable vital signs were observed, enema was discontinued and surgical management was proposed. If intussusception recurrence was observed in the next hours, PR was performed again whenever possible.

Treatment

After fluid and electrolyte correction, PR was performed by using air through an 18 F urinary catheter applied to the rectum under continuous imaging guidance by C-arm. With child in a supine position, a Foley catheter was introduced in the rectum and maintained by inflating its balloon with 40 ml saline; the buttocks were joined with a band aid to avoid leaks. The rectal cannula was connected to Sphygmomanometer inflatable cuff initially about 80 mmHg increasing up to a maximum of 120 mmHg. The passage of air into the ileum through the ileocecal valve ensures successful reduction. No time limit was imposed on the duration of the procedure; however, cessation of retrograde movement of the intussusception for more than 15 min was regarded as a failed attempt. The procedure was repeated 20 min later, with a maximum of three attempts.

All children were kept under medical supervision, no oral intake was permitted for the next 24 h and intravenously fluids and antibiotics were given. After 12–24 h, ultrasonography was repeated to exclude early recurrence.

Statistical analysis

Analysis of quantitative and qualitative data was performed for all items. Continuous data were expressed as mean. The intergroup differences were assessed by the χ^2 test as needed for categorical variables; the univariate analysis of variance was performed for parametric variables. P values were two-sided and $P<0.05$ was considered statistically significant.

Results

A total of 470 cases were gathered from medical records and included in our study, the demographic and pathological data are summarized in Table 1. In all, 82.3% of cases (387 patients) were below 1 year of age, whereas 17.7% (83 patients) were older patients. Clinical presentation and correlation with treatment

Table 1 Demographic data

	All	PR success[a]	PR failure[b]	Primary surgery[c]	*P*
Number	470	244	24	202	<0.05
Age (mean years)	2.56	2.3	2.79	3.72	
Sex (M/F)	326/144	147/97	18/6	161/41	
Lead points	24	0	9	15	<0.05
Type of invagination					
Ileoileal	6% (28)	0	18	10	<0.05
Ileocecal	83% (390)	226	12	152	<0.05
Left colon involved	11% (52)	15	13	24	<0.05

PR, pneumatic reduction.

Table 2 Clinical presentation and outcome

	Total	PR success[a]	PR failure[b]	Primary surgery[c]	*P* value
Number	470	244	24	202	<0.05
Abdominal pain	470 (100%)	244 (100%)	24 (100%)	202 (100%)	<0.05[a] vs.[b,c]
Vomiting	273	134	24	115	<0.05[a] vs.[b,c]
Rectal bleeding	241 (51%)	44	15	182	<0.05[a,b] vs.[c]
Diarrhea	118 (25%)	61	14	43	<0.05[a] vs.[b,c]
Abdominal palpable mass	310 (66%)	130	8	172	<0.05[a] vs.[b,c]
Abdominal pain + vomiting	296 (63%)	146	14	136	<0.05[a] vs.[b,c]
Abdominal pain + rectal bleeding + abdominal palpable mass	151 (32%)	36	8	107	<0.05[b] vs.[a,c]

PR, pneumatic reduction.

is described in Table 2. The most frequent symptoms observed were abdominal pain (100% of cases) and vomiting (72%); characteristically, it was shown that only 29% of patients presented with the classic triad of symptoms (abdominal pain, palpable mass, and blood-stained stools), whereas 73% presented both abdominal pain and vomiting miming gastroenteritis. Ultrasonography was the method of diagnosis in 100% of cases, with typical images visualized in upper and lower right quadrant in 80% of cases and in 86% the diameter of intussusception was greater than 3 cm.

The commonest site of intussusception was ileocaecal (83%). Ileoileal occurred in 6%, whereas left colon was involved in 11% of cases.

Among all cases, 57% (268) patients were managed conservatively with PR under image with an average of 1.8 attempts made during a single procedure. Thanks to early intervention, age of the child, and site of mass, 240 cases were ileocecal in children less than 2 years. Surgical intervention was performed in 226 cases, primary surgery (which means surgery without trials of PR) in 202 patients (43%), and the secondary operative intervention was performed in 24 patients (5%) who had failed initial nonoperative management of intussusception. Manual reduction of intussusception was performed in 181 patients (80%), 45 patients had resection of gangrenous bowel with end-to-end anastomosis, whereas 2 patients (1%) had spontaneous reduction of intussusception that was discovered at laparotomy. The mean duration of hospital stay was 12.1 days (range 3–60 days). A total of 43% (202) patients required primary surgical intervention because of clinical conditions with sign of acute abdomen and in 24 (5%) a pathological lead point was observed during surgery. The total percentage of operated patients was 44%, with lead points identified in 24 cases: 8 Meckel diverticulum, 4 polyp, 2 focal solid lesion, and 10 hypertrophic lymph nodes (diameter >1 cm). There was a complication after surgical treatment, in the form of mortality in 1% (5 patients), and 3 patients (0.6%) had recurrence of intussusception; only 15 patients had delayed oral feeding resumption with need of prolonged parenteral nutrition.

Table 3 Season classification

Season	Number of patients (%)
Winter	92 (19.57)
Spring	176 (37.44, *P*<0.05)
Summer	117 (24.89)
Autumn	85 (18.08)
Total	470 (100)

The recurrence (early recurrence) rate was 6% (28 patients) during the hospitalization, and all after PR; of these, 9 were treated again with PR, whereas 19 underwent surgery. During the follow-up of 3 years, only two patients were found to have recurrence (late recurrence): one treated with PR and one operated.

According to the data gathered from personal history sheets, 92 (19.57%) patients were presented in winter, 176 (37.44%) patients in spring, 117 (22.77%) patients in summer, and 85 (15.96%) patients in autumn, with peak of incidence occurred in spring. Moreover, patients were evenly distributed throughout the entire year with peak incidence occurring in June (15.31%), whereas the least incidence (4.45%) was in December. Regarding sex, 326 (69.36%) men and 144 (30.64%) women were candidate for the research with a ratio nearly 2 : 1 (Tables 3 and 4).

Discussion

Intussusception is the most common acquired cause of intestinal obstruction in children aged 4 months to 2 years with a peak of incidence between 4 and 9 months of age [1]. The incidence of intussusception may differ according to weather and seasons. Knowing the seasonal variations may enable the researchers to know more about the causes and the prevention and management of intussusception.

Table 4 Month distribution

Month	Number of patients (%)
December	21 (4.45)
January	32 (6.8)
February	39 (8.30)
March	47 (10)
April	60 (12.7)
May	62 (13.19)
June	72 (15.31, $P<0.05$)
July	28 (5.96)
August	24 (5.11)
September	27 (5.75)
October	26 (5.53)
November	32 (6.80)
Total	470 (100)

Mode of management of intussusception differs according to the time of presentation. Early presentation enables success of nonsurgical methods such as pneumatic and hydrostatic reductions, whereas late presentation makes surgery mandatory and may increase the morbidity and mortality.

In our centers, we tried PR as a nonsurgical and effective method for early case. Trials of PR may reach up to three trials for the same patient.

Research was done on 470 patients prospectively suffering from acute intussusception, to study seasonal variation and mode of management in pediatric surgery in El-Minia University Hospital from January 2014 to December 2018.

Regarding age of incidence, 83% were below the first year, whereas Awasthi *et al.* [9] recorded 62% of their cases below the first year of age.

Regarding sex, 326 (69.36%) men and 144 (30.64%) women were candidate for the research with a ratio nearly 2 : 1, same as the study of Vujović *et al.* [11], close to the normal ratio varying 2.5 : 1 to 3 : 1 and in other studies of Blanco *et al.* [12] with a male : female ratio of 1.8 : 1.

From our finding, 92 (19.57%) patients were presented in winter, 176 (37.44%) patients in spring, 117 (24.89%) patients in summer, and 85 (18.08%) patients in autumn, with peak of incidence occurred in spring, which is corresponding to data gathered by Bines *et al.*, and in contrast to the study of Parashar *et al.* [13] who stated that the peak incidence occurred in winter and in contrast of Awasthi *et al.* [9] who reported no seasonal variations noticed.

Moreover, patients were evenly distributed throughout the entire year with peak incidence occurring in June (15.31%), whereas the least incidence (4.45%) was in December, which is similar to the study of Niramis *et al.* [10]. This variation with high incidence in spring may be due to high incidence of upper respiratory tract infection secondary to allergies in spring.

In clinical presentation results, abdominal palpable mass was found in 66% of cases where 55% of them required a primary surgical intervention and those were more than 85% of total surgical cases, and most of PR failure was in cases presented with vomiting and all of them were complaining of abdominal pain; this comes with the same results of Awasthi *et al.* [9].In management of early cases with intussusception, PR was a successful technique in 53% of cases, whereas primary surgical decision was done in 42% of cases, only 5% needed a surgery after PR trails failure.

Regarding mode of management out of 470 cases, 268 cases (57%) underwent trial for PR, 244 patients (53%) were successfully reduced and the rest needed surgical intervention in the form of simple reduction in 161 (80%) cases and resection anastomosis in 41 (20%) cases of all surgical cases. Daneman and Navarro [14] had nearly the same results.

Regarding the number of trials of PR, 63% were successfully reduced on the first trial, 26% were successfully reduced on the second trial after failing first trial, and 11% were successfully reduced on the third trial after failing two trials, showing that multiple trials increase rate of PR success, as stated by Dahab *et al.* [15]. Patients underwent nonsurgical approaches (PR) before considering surgery unless pneumoperitoneum or prolapsed intussusception is present. Lehnert *et al.* [16] stated that PR is preferred over hydrostatic.

Conclusion

Seasonal peak of intussusception was in spring till June, so precautions in dealing with cases of intestinal colic and vomiting in the form of early detection by U/S or clinical exclusion should be considered.

PR is effective in early presentation and we can do up to three trials for the same patients before shifting to surgery.

The success of PR can be increased by repeating up to three attempts to reduce the need for surgical intervention.

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Conflicts of interest
The authors whose names are listed certify that they have no affiliations with or involvement in any organization or entity with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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