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Original Article

A 11-year retrospective analysis of intussusception cases in children

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ABSTRACT

Objective: Intussusception is a prevalent etiology of emesis and abdominal discomfort in pediatric patients. This investigation sought to elucidate the correlation between epidemiological factors, clinical progression, diagnostic procedures, therapeutic interventions, and patient outcomes, with particular emphasis on the safety profile of hydrostatic reduction in subjects presenting with intussusception.

Material and Methods: In this retrospective study, we analyzed the data of children who were diagnosed and treated for intussusception in the hospital database and the Picture Archiving and Communication Systems (PACS) from January 2013 to December 2023. Demographic data, symptoms at presentation, mode of diagnosis, treatment modality, and associated complications were also recorded.

Results: Of the 165 patients, 60% were boys and 40% were girls, with a mean age of 35.5 years (1-193 months). Of the patients, 44.2% (n= 73) were presented within 24 hours of symptom onset. All patients had abdominal pain, and 24 (14.5%) had the classic triad of abdominal pain, vomiting, and red stools. Ultrasonography-guided hydrostatic reduction (USHR) and surgery resulted in a cure in 134 (93.3%) and 31 (6.7%) patients, respectively. The overall recurrence rate was 16.3%, with no mortality. There was a statistically significant difference between the length of the invaginated segment (4 cm or more) and USHR (p=0.004).

Conclusion: The USHR of invagination is effective regardless of the duration of symptoms and number of recurrences.

Keywords: Child, intestinal obstruction, intussusception, surgery, ultrasonography

INTRODUCTION

In 1793, the Scottish Surgeon James Hunter published the first description of intussusception. According to his definition, the proximal intestine is telescoped into the distal intestinal segment. The associated mesentery becomes entrapped within an invaginated segment, resulting in venous congestion and edema. If left untreated, this condition progresses to ischemia, subsequently leading to intestinal necrosis, perforation, and peritonitis. Consequently, intussusception in pediatric patients constitutes a medical requiring prompt diagnosis and intervention.

Intussusception is a prevalent cause of abdominal pain and vomiting in pediatric patients. The clinical signs of the condition include persistent episodes of crying, abdominal pain, a palpable abdominal mass, abdominal distension, and viscous bloody stools. The majority of intussusceptions in children are primary and typically occur as ileocolic (85%), ileo-ileocolic (5%), colocolic (2.5%) or jejunojejunal (2.5%) (1,2). In infants and young children, most cases are idiopathic, and the etiology of intussusception is generally attributed to hypertrophic lymphoid tissue in the terminal ileum; however, leading points such as Meckel's diverticulum, polyps, duplication cyst, lymphadenopathy, lymphoma, and foreign body may be identified (3).

Abdominal ultrasonography (US) serves as the primary diagnostic modality for the investigation of intussusception due to its high specificity, sensitivity, and absence of radiation exposure. Kim et al. (4) reported the first successful sonography-guided hydrostatic reduction of intussusception in 1982. Subsequently,

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ultrasound-guided saline enema reduction techniques have become the initial treatment of choice in numerous institutions, demonstrating favorable outcomes and minimal complications. Imaging-guided hydrostatic reduction has significantly diminished the necessity for surgical intervention. Surgical or laparoscopic reduction is indicated when bowel necrosis or perforation is suspected or when treatment with USHR proves ineffective (3).

This study aimed to elucidate current concepts pertaining to the diagnosis, treatment, complications, and recurrence of intussusception in pediatric patients.

MATERIALS and METHODS

The medical records of 165 patients diagnosed with intussusception who presented to the emergency department of Kocaeli University hospital between 2013 and 2023 and were treated and followed up by pediatric surgery were retrospectively reviewed and analyzed. All children under the age of eighteen were included in the study, and those with incomplete clinical data were excluded. The age, sex, presenting symptoms, clinical findings, time of presentation, diagnosis, and treatment modalities of the patients were evaluated and discussed in the context of the existing literature. A diagnosis of intussusception was established using US and computed tomography (CT). The non-surgical treatment method, USHR, was employed as the primary intervention. USHR was performed in the absence of clinical or imaging findings suggestive of pathological leading points, and in the absence of peritonitis or intestinal necrosis.

The procedure was thoroughly explained to the parents, informed consent was obtained for the hydrostatic reduction procedure, and the patient remains unsedated. Following the diagnosis of intussusception, an enema was administered for routine bowel preparation, and a nasogastric tube was inserted to prevent emesis and aspiration. The children were subsequently positioned in the lithotomy position, with the hips elevated to 30°. An age-appropriate Foley catheter was advanced rectally, the balloon was inflated, and the catheter was retracted and inserted into the entrance of the anal canal through the rectum. Saline, heated to 35–40°C, was then allowed to flow gradually into the colon under the influence of gravity from a height of 100-120 cm above the anus. In pediatric patients, the enema volume was adjusted to ensure that the total volume of saline did not exceed 1000 mL. Reduction of the invaginated segment and potential complications were monitored in real-time using ultrasound by a radiologist. A maximum of three attempts was permitted for this reduction. Each attempt continued as long as the mass demonstrated progressive reduction in size, as observed via ultrasound. If reduction was not achieved after the third attempt, the procedures were terminated, and operative preparation for surgical reduction was initiated. Patients who underwent successful USHR were allowed to evacuate the normal saline enema from their colon. Prior to Foley catheter removal, control ultrasound was performed to confirm complete reduction of the intussusception and exclude complications. Patients were kept under observation for a minimum of 24 hours to monitor for late complications and recurrence. The following day, patients with normal control ultrasound findings were discharged.

Statistical Analysis

The variables were investigated using visual and analytical (Kolmogorov–Smirnov/ Shapiro–Wilk test) methods to determine whether or not they are normally distributed. Descriptive analyses were presented using medians, interquartile range (IQR), minimum, and maximum for the nonnormally distributed and ordinal variables, means and standard deviations for normally distributed variables. The categorical data were analysed as frequency and percentage. Chi-square test was used to compare proportions in different groups. Mann-Whitney U test were used to compare nonnormally distributed parameters. A p value of less than 0.050 was considered to show a statistically significant result.

RESULTS

During the study period, 165 children diagnosed with intussusception were treated. The cohort comprised 99 males and 66 females, with a male-to-female ratio of 1.5:1. The subjects' ages ranged from 1 to 193 months, with a mean age of 35.5 months. The most prevalent age range was between 6 and 12 months.

The duration of symptoms ranged from 2 to 240 h, with a median duration of 32 h. The precise duration of intussusception symptoms is often challenging to ascertain and is contingent upon the recognition of non-specific symptoms, which are frequently poorly articulated in young children. The most prevalent symptoms were colicky abdominal pain (100.0%), vomiting (54.5%), and rectal bleeding (26.0%). The classical clinical triad, characterized by intermittent abdominal pain, stool with a consistency resembling strawberry jelly, and sausage-shaped abdominal masses, was observed in 24 patients (14.5%). Forty-three patients exhibited bloody stools, and the mean age of the patients with bloody stools was 24 months, while the mean age of the patients without bloody stools was 40 months. A total 58.1% (n= 96) patients presented within the first 24 hours after the onset of abdominal pain, while 41.9% (n= 69) presented after 24 hours. Invaginated segments less than 4 cm (62.4%) and segments >4 cm (37.5%) had statistically significant differences in USHR performance (p=0.004). All patients were diagnosed through the use of ultrasound imaging (Figure 1,2)

The invagination types and rates are presented in Table I. Among the 162 patients who underwent ultrasound-guided hydrostatic reduction (USHR), successful reduction was achieved in 137 cases, representing an 84.5% success rate. Additionally, four patients who experienced recurrence were

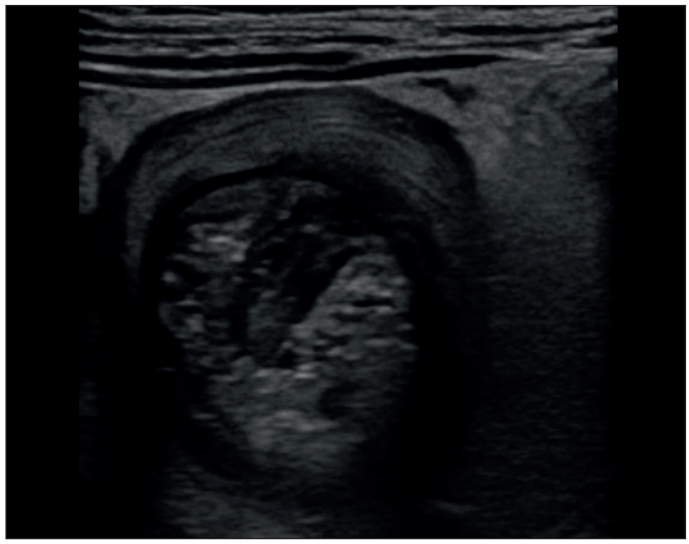

Figure 1: Target sign in ultrasonography imaging

Figure 2: The "sleeve" sign of the intussusception was shown on the longitudinal section

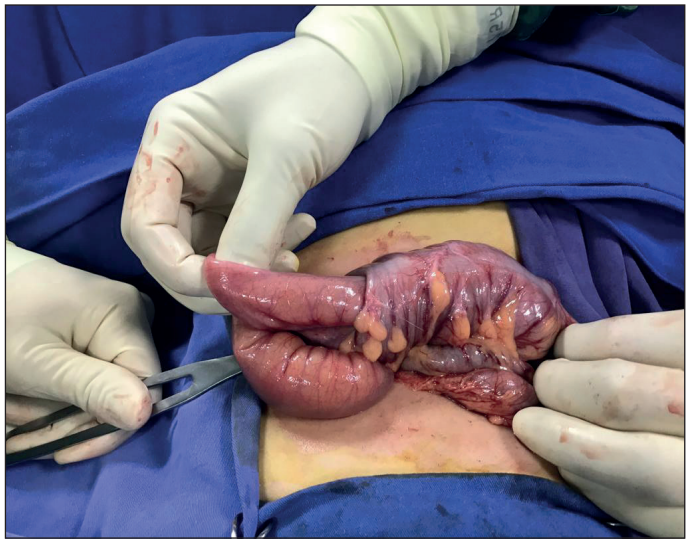

Figure 3: Ileocolic intussusception

Table I: The intussusception types and rates

Intussusceptions	n (%)
Ileocolic	152 (92.2)
Ileoileal	6 (3.6)
Colocolic	5 (3.0)
Ileocolic and ileoileal	2 (1.2)

Table II: The surgically treated intussusception types and rates

Intussusceptions (surgically treated)	n (%)	Manual reduction	Manual reduction and Meckel excision (%4.2)	Resection anastomosis
Ileocolic	26 (66.6)	18	5	3
Ileoileal	10 (25.7)	6	2	2
Ileocolic and Ileoileal	2 (5.2)	2		
Colocolic	1 (2.5)	1		1

successfully managed with subsequent USHR procedures. Notably, no instances of perforation were observed during the procedure in any patient

Hydrostatic reduction demonstrated efficacy in subjects with brief symptom duration; however, the observed difference did not reach statistical significance (p=0.159). A total of 39 (23.6%) patients necessitated open surgery due to partial reduction of invagination/failed reduction, unsuitability for USHR, or recurrence (Figure 3). Recurrence was observed in ten (6.0%) patients. Among these patients, four (15 days-15 months) were managed with repeat USHR and five with open surgery. One patient experienced recurrence following open surgery and was treated accordingly again. A male neonate, aged three days, who had previously undergone surgical intervention for a diaphragmatic hernia, subsequently developed ileoileal intussusception on the second day following the operation. Furthermore, one patient presented with a total of eight ileoileal intussusceptions in conjunction with ileo-colic intussusceptions.

The types and rates of surgically treated intussusceptions are presented in table II. In the present study, the required bowel resection rate was 15.8%. Three of the patients who underwent anastomosis presented with circulatory disturbances, while the others exhibited a leading-point mass, hemangioma, and polyp, respectively. No mortality was observed in this study.

DISCUSSION

Infants predominantly experience small intestinal obstruction due to intussusception, which constitutes the second most

common cause of acute abdominal pain in pediatric patients after appendicitis (1,2,5). The incidence of intussusception typically ranges from 15 to 300 cases per 100.000 children annually, with a male-to-female ratio of approximately 1.2–2.1:1 (6-8). Approximately 75-90% of cases are idiopathic, and the presence of lymphoid hyperplasia is reported in the majority of cases (1,5,9). Among the patients in this study, 93.9% presented with idiopathic disease as shown in Figure 1.

In 1.5–12% of intussusception cases, a pathologic leading point is present. Although polyps, tumors, lymphomas, duplication cysts, parasites, hematomas, vascular malformations, inflammatory appendices, and inverted appendiceal roots have been identified as etiological factors, Meckel's diverticulum remains the most prevalent point of origin in infants. The leading points (6.0%) in our series comprised vascular malformation, lymphoma, and Meckel's disease. Additional recognized risk factors for intussusception include nephritic syndrome, Peutz-Jegher syndrome, familial polyposis, Henoch-Schonlein purpura, and cystic fibrosis. Furthermore, intussusception has been documented during the postoperative period and in association with abdominal injuries (1,2). Postoperative ileoileal intussusception was observed in a patient who underwent surgery for diaphragmatic hernia and was subsequently managed with manual reduction.

The majority of pediatric patients present with primary intussusceptions, with the ileocolic type being the most prevalent. Intussusceptions can be categorized as single or multiple based on their quantity. Single intussusceptions are predominantly ileocolic, ileo-ileocolic, or colocolic, while multiple intussusceptions are typically ileoileal or jejunojejunal. In our study, two patients (1.2%) exhibited multiple invaginations. One patient presented with a total of eight ileoileal invaginations in conjunction with ileo-colic invaginations. The highest number of invaginations reported in the literature is 10, which is attributed to secondary trauma (10).

The initial symptom in 80-95% of cases is the acute onset of abdominal pain, typically characterized by cramping for 15-20 minutes, which is severe and progressive in nature (1). Patients may experience complete asymptomatic periods between episodes. In cases of prolonged intussusception, ileus advances, and symptoms of peritonitis may manifest when perforation occurs. In 50-70% of cases, the presence of overt or occult blood in the stool has been documented, exhibiting a characteristic strawberry jelly appearance due to a mixture of blood and mucus. It is crucial to remember that the diagnosis of intussusception is not ruled out if there is no blood in the stool.

The classic clinical triad of Ombredanne syndrome comprises an elongated abdominal mass, feces resembling strawberry jelly, and intermittent abdominal pain. This triad is observed in 7.5–40% of cases, and our incidence aligns with the reported figure of 14.5% in the literature (2,11). Additionally, this condition has been associated with other manifestations, including emesis (60%), diarrhea (30%), lethargy, lacrimation, altered mental status, sepsis, shock, and syncope (1). Delays in diagnosis and treatment reduce the success rate of USHR and increase the probability of bowel resection. However, Wong et al. (12) reported that a mean symptom duration of 2-3 days did not affect the success rate of reduction. Conversely, Chung et al. (13) investigated the risk factors for surgical reduction and determined that prolonged symptom duration (> 24 h) was a risk factor for failed reduction. There was no statistically significant difference between the success of USHR decrease and the duration of symptoms in our study (p=0.159). We posit that the length of the invaginated segment is more significant than the duration of symptoms in determining the success of USHR.

Abdominal radiographs exhibit low sensitivity (29-50%) and are consequently not recommended for the diagnosis of intussusception. Nevertheless, this modality may yield more findings in cases of suspected perforation (6). US serves a crucial role in the diagnosis of intussusception. In pediatric patients, US reduces the cost of screening and radiation exposure, demonstrating a sensitivity of 98%-100% and specificity of 88-100% (1,14). Characteristically "donut," "pseudokidney," or "target sign" are considered diagnostic indicators on ultrasound as shown in Figure 2-3 (1). US additionally contributes to the evaluation of decreased invagination, the presence of a pathologic leading-point mass, and alternative diagnoses (2,15). Due to its high sensitivity and specificity, US should be considered the primary diagnostic tool for radiation protection, while abdominal CT should be employed when a definitive diagnosis cannot be established (1,7).

No standardized guidelines exist for the management of pediatric intussusception. Pediatric patients presenting with a high clinical suspicion of intussusception who are hemodynamically and clinically stable, or who exhibit radiologic evidence of intussusception without signs of intestinal perforation, are optimally managed through nonoperative intervention. In developed countries, nonoperative reduction has become the gold standard in the treatment of intussusception, and the success rate of reduction based on published literature has reached at least 80% and up to 100% (8,16,17). USHR was the primary conservative technique employed at our center to avoid radiation exposure, and our success rate was consistent with the literature (84.5%). Nonoperative treatment methods include fluoroscopic- or ultrasound-guided barium reduction and air or saline reduction. Saline reduction results in less morbidity when perforation occurs compared with barium and water-soluble ionized contrast agent reduction techniques. There is no chance of chemical peritonitis or electrolyte imbalance if intestinal perforation occurs when using saline techniques (7,18).

Dehydration should be treated with intravenous fluid resuscitation prior to reduction. In the majority of cases involving

acute primary intussusception, a non-operative reduction should be attempted. However, pediatric patients exhibiting symptoms of peritonitis, shock, sepsis, or the presence of free air on abdominal radiographs are not appropriate candidates for this procedure. The primary benefit of USHR is the elimination of radiation exposure in pediatric patients. This allows for repeated and systematic attempts at reduction. In cases where USHR treatment was initially successful, four patients who experienced recurrence were effectively managed with subsequent USHR procedures. The most significant adverse effect of enema reduction is perforation, which occurs in approximately 1–10% of cases (1,2,7). Infants under six months of age are particularly susceptible to perforation, potentially due to the reduced thickness of their intestinal walls (19). The duration of symptoms in these instances is typically reported to be 36–48 hours or more, and the interval between symptom onset and intervention has been identified as a contributing risk factor (19). The failure of hydrostatic reduction has been associated with several parameters, including young age, rectal bleeding, radiologic evidence of intestinal obstruction, and prolonged symptoms (>72 h) (18, 20). Nevertheless, provided the patient is clinically stable and adequately hydrated, these symptoms do not preclude hydrostatic reduction. To enhance the likelihood of non-operative reduction in numerous patients, it is essential to prevent delayed presentation and to establish an accurate diagnosis promptly.

Following enema administration, the recurrence rate of intussusception ranges from 5% to 20%, irrespective of whether air or liquid reduction techniques are employed (8,21,22). In the present study, the recurrence rate subsequent to USHR (6%) was consistent with previously reported findings. Recurrence rates diminish to approximately 1% when surgical reduction is performed, attributable to the formation of adhesions (23). Nevertheless, the postoperative recurrence rate was observed to be 2.5%.

Surgical intervention is necessitated when reduction with USHR proves unsuccessful and pathological leading point or bowel necrosis is present. The requirement for bowel resection ranges from 25% to 40%, with our rate being lower at 15.8% (24-29). Surgical intervention can be executed via both open and laparoscopic approaches in patients with intussusception.

A more favorable prognosis is generally observed in patients when a reduction occurs within 24 hours of symptom onset. Delayed presentation is associated with decreased reduction rates, an increased necessity for surgical intervention, and associated complications (29). In most regions globally, the mortality rate of intussusception is exceedingly low (<1%). However, mortality rates of up to 9.4% have been reported in Africa (5).

This study's retrospective methodology and absence of a controlled comparison of therapies were its primary limitations.

CONCLUSION

Ultrasound-guided hydrostatic reduction (USHR) should be considered the conservative intervention of choice for the treatment of intussusception due to its cost-effectiveness, efficacy, safety, and elimination of radiation exposure risk. The success rate can be enhanced through the involvement of trained radiologists and the establishment of standardized procedures, including the number and duration of interventions. We propose the adoption of USHR as the standard technique for the management of childhood intussusception.

Ethics committee approval

This study was conducted in accordance with the Helsinki Declaration Principles. The study was approved by Kocaeli University (18.01.2024, reference number: KÜ GOKAEK-2024/01.12).

Contribution of the authors

Çalışmanın konsepti ve tasarımı: ***VO, AMA***; veri toplama: ***VO, AMA, TBN, SB***; sonuçların analizi ve yorumlanması: ***O, AMA, TBN, SB, EYG***; taslak makale hazırlığı: ***VO***. Tüm yazarlar sonuçları gözden geçirdi ve makalenin son halini onayladı.

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Conflict of interest

The authors declare that there is no conflict of interest.

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