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Research Article

Risk Factors for Pediatric Emergency Patients' Hydrostatic Intussusception Reduction Attempts

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Abstract

Background: Intussusception is a medical emergency that can compromise local circulation, leading to tissue necrosis and infection-related mortality in affected children. It is caused by the proximal entry of an intestinal segment into its own lumen. The primary non-operative treatment for intussusception is hydrostatic reduction, a noninvasive method associated with a lower risk of complications.

Method: This study included the medical records of children with intussusception who underwent either surgical intervention or hydrostatic reduction between September 2015 and August 2020. Descriptive statistics such as means, medians, standard deviations, ranges, and percentages were used to describe the study variables. Binary logistic regression analysis was performed to identify relevant variables, and the estimated effect size and statistical significance were presented using 95% confidence intervals and adjusted odds ratios (AOR).

Results: The study examined 157 participants, of whom 38 (24.2%) received conservative care, with the majority having ileo-ileal intussusceptions. Thirty-eight patients (24.2%) underwent immediate surgery, while 80 patients had an ultrasound-guided attempt at hydrostatic reduction using warm normal saline. Of these 80 patients, 48 (60%) experienced a successful hydrostatic reduction, while 32 (40%) experienced failure. No deaths or life-threatening conditions were identified in this study.

Conclusion and Recommendations: Hydrostatic reduction was found to be a safe procedure at Tikur Anbessa Specialty Hospital. The duration of the illness and the resilience of the intestine were critical factors in the success of the procedure. The study recommends promptly referring patients to major hospitals upon suspicion of intussusception.

Keywords: Intussusception, Pediatrics, Hydrostatic Reduction

Introduction

The term "intussusception" was initially used to describe a condition by Barbette in 1674; however, it was not until 1831 that Wilson successfully performed surgery on this condition. Hirschsprung provided the first descriptions of the hydrostatic reduction method in 1876 and 1905. After analyzing a total of 107 cases, he discovered that intussusception accounted for 35% of mortality [1,2].

Intussusception involves the pathological invagination (telescoping) of a proximal segment of the intestine into a distal section, leading to symptoms such as constriction of the mesentery, venous obstruction, and edema of the gut wall. Acute intestinal blockage is one of the most common conditions it can induce. Intussusception is a significant factor in the need for bowel resection in young children and newborns in developing countries [1,2,3].

Intussusception occurs in approximately 10% of children over five years old, 3% of those over ten years old, and 4% of infants under three years old [3,4]. In certain populations, the incidence of intussusception peaks during the season for viral gastroenteritis [4]. Typically affecting children aged 4-36 months, intussusception beyond this age range may be associated with a pathologic lead point, such as a tumor, hematoma, polyp, duplication cyst, reactive lymphoid hyperplasia, Meckel diverticulum, Ascaris lumbricoides, ectopic pancreatic tissue, anastomotic suture line, enterostomy tube, post-transplant lymphoproliferative disease, gastrojejunal, or jejunostomy tubes [5,6,7].

Ultrasound is the preferred diagnostic tool for detecting intussusception in hospitals, offering a sensitivity and specificity range of 97% to 100%. A skilled sonographer can reliably rule out intussusception with a negative study, given the nearly 100% negative predictive value [8,9].

Treatment strategies for children with intussusception fall into two main categories: operative and non-operative management. One non-surgical option is the contrast enema, which involves injecting contrast material into the rectum via a catheter to reduce the intussusceptum by increasing intraluminal pressure. This process can be guided by ultrasonography, liquid contrast material, or fluoroscopy, with ultrasound reducing radiation exposure compared to fluoroscopy [10,11,12,13].

This study aims to assess the outcomes and risks of non-operative intussusception treatment.

Methodology

This study was conducted at Addis Ababa University in Ethiopia, specifically within the pediatric emergency unit and the department of pediatrics and child health. Pediatric surgical patients were admitted to the pediatrics department, which includes a specialized pediatric surgical unit with a capacity of 19 beds for both elective and emergency surgical situations. This facility is the only public hospital in the area providing comprehensive care for children with pediatric surgical emergencies.

A total of 157 participants were recruited for this study, all of whom had visited the pediatric emergency room within the past five years presenting with symptoms suggestive of an acute abdomen and suspected intussusception. Inclusion criteria were met by patients aged between 7 days and 15 years who underwent either hydrostatic reduction or surgery for intussusception. Neonatal patients with alternate diagnoses and those with missing medical records were excluded from the study.

Participants were divided into two groups: the unsuccessful reduction group and the successful reduction group. Data were extracted from patient records using pretested, standardized data collection tools and analyzed using SPSS for Windows version 23. Descriptive statistics, including percentages for nominal variables, means, medians, and standard deviations, were used for the analysis. The Chi-square test and binary logistic regression analysis were employed to investigate the relationships between variables. Data were presented and distributed effectively using tables, pie charts, and graphs.

Procedure

The hydrostatic reduction procedure was performed by a pediatric surgeon under ultrasound guidance, using a transducer with a frequency range of 5 to 10 MHz. A Foley catheter was inserted into the patient's anus, and the buttocks were taped to prevent fluid leakage. The surgeon conducted three attempts at a pressure enema of 100–120 cmH2O, each lasting three minutes. Continuous pressure was applied using a balloon, and sedation was provided throughout the procedure.

The effectiveness of the reduction was evaluated using two criteria: the cessation of intussusception, indicated by the passage of sterile water through the ileocecal valve, and the absence of intussusception during the ultrasound examination.

Ethics related matter

Ethical approval for this study was granted by the Department of Research and Ethics Committee (REC). To respect participants' privacy, their names were omitted from the questionnaire. Collected data were kept confidential and used exclusively for the purposes of this study, accessible only to the lead investigator. The study adhered to the principles of the Helsinki Declaration.

Operational Definitions

- **Hydrostatic Reduction Failure:** Intussusception not completely alleviated by ultrasound-guided saline attempts.
- **Successful Reduction:** Complete disappearance of the intussusceptum with saline reflux into the ileum.
- **Lead Point:** An intestinal lesion or variant causing intussusception by being pulled into a distal portion of the gut by peristalsis.
- **Late Presentations:** Presenting after 48 hours with significant symptoms.
- **Recurrent Intussusception:** Recurrence of intussusception following resolution, whether naturally or by intervention.

Results:

Socio-demographic Elements:

Among the 157 patients, 95 (60.5%) were male, resulting in a male-to-female ratio of 1.5:1. The ages of the patients ranged from three months to twenty-five months, with a median age of twelve months. The majority (72%) of participants were from Addis Ababa. The most prevalent clinical manifestations were vomiting (63, 40.1%) and abdominal pain (56, 35.7%).

Of all participants, 50 (31.8%) presented to the hospital for the first time after 24 hours of illness, and 65 (41%) presented after four or more days. Over half of the subjects (67, 42.7%) had a normal body temperature, while 46 (29.3%) were febrile, and 40 (25.5%) were hypothermic.

(Tab 1)

Treatment and Outcomes:

Out of the 157 patients, 39 received conservative care, 80 (51%) underwent hydrostatic reduction, and 38 (24.2%) required surgical management. Among the 80 patients who underwent hydrostatic reduction, 48 (60%) were successful**. (Figure1)**

There were 50 (62.5%) single attempts, 25 (32.2%) second attempts, and 4 (5%) third attempts at hydrostatic reduction. While there were no fatalities as a result of hydrostatic reduction, 6 (7.5%) of the patients experienced recurrence. Six (8.5%) of the individuals who underwent surgical treatment had complications, including surgical site infections, wound dehiscence, and abscess collection. Two patients died—one before intervention and one during surgical intervention—but the vast majority (98.7%) made

progress.

Patients who presented after 48 hours had a failure rate three times higher than those who presented within 48 hours, with a statistically significant p-value of 0.033.**(Tab 2)**

The CNS condition of participants at the time of presentation was not related to the success of hydrostatic reduction. **(Tab 3)**

Factors Affecting Hydrostatic Reduction:

Clinical presentation influenced the hydrostatic reduction outcome. Binary logistic regression indicated a p-value of less than 0.05 for variables such as abdominal bulk, rectal hemorrhage, free intraperitoneal fluid, and antibiotic use. These variables were associated with unsuccessful hydrostatic reduction, with adjusted odds ratios (AOR) higher than 2, indicating a strong link. **(Tab 4)**

Pulse rate was significantly correlated with intussusception outcomes (p-value 0.014, AOR 1.1, 95% CI 1.02-1.2). Similarly, white blood cell (WBC) count was correlated with patient outcomes. **(Tab 5)**

Discussion

The median age of patients in this study was 12 months, with the highest incidence of intussusception occurring in the 3 to 25 months age range. This finding aligns with previous research indicating that acute intussusception is common in young infants. Studies have shown that infants under one year of age are the most frequently affected group [15, 16, 17]. However, the Jimma Ethiopian study did not identify any cases of intussusception in newborns younger than six months [17].

The male-to-female ratio in our study was 1.5:1, similar to ratios observed in prior studies [18, 19, 20]. In contrast, the male-to-female ratio in the Bangladesh study was 2.2:1 [21].

Our study found that intussuscepted toddlers under the age of two exhibited a range of clinical signs, including stomach discomfort in 35.7% of cases, bloody stools in 10.8% of cases, and the classic triad (vomiting, stomach discomfort, rectal bleeding or bloody feces) in 20.4% of cases. These findings differ from earlier investigations, where the classic triad was present in 10% and 66% of patients, respectively [22, 23]. Another study reported the triad in 11.9% and 60% of subjects, respectively [24, 25].

The success rate of hydrostatic reduction in our study was 60%, which is lower than the success rates reported in studies from Egypt and India (87% and 88.7%, respectively) [24, 25]. However, it was higher than Indonesia's 16% success rate, where dehydration was a significant factor for failure [26]. Smaller bowel diameters in young children may contribute to the difficulty in reducing the strangulated intestine [27].

Our study identified significant risk factors for unsuccessful hydrostatic reduction, including symptoms lasting 48 hours or more, rectal bleeding, palpable abdominal mass, and free peritoneal fluid [28, 29]. These factors are related to the disease process and its presentation. Age under two years was strongly associated with unsuccessful reduction, likely due to the small bowel size in young children, making intussusception difficult to treat.

Reijnen et al. [30] noted that the persistence of symptoms for 48 hours or more is a significant indicator of hydrostatic reduction failure. Our study found that symptoms lasting 48 hours or more significantly increased the likelihood of failure, possibly due to the decreased adaptability of the intestine with prolonged symptom duration before therapy. Rectal bleeding and abdominal mass were the two most common clinical signs of intussusception in our study and significant risk factors for reduction success. He et al. also identified rectal bleeding as a predictor of reduction failure [26].

A significant abdominal bulge was another indicator of a failed procedure. A palpable abdominal mass was a substantial risk factor for reduction failure in both our study and Wong et al.'s investigation [27].

Limitations

This study has some limitations. It was conducted at a single site, and the sample size was small, limiting the generalizability of the results. Despite these limitations, our findings highlight risk factors for hydrostatic reduction failure in pediatric intussusception patients.

Conclusion

Our research indicates that failure of hydrostatic reduction in intussusception was observed in patients under one year of age, those with symptoms persisting for 48 hours or more, and patients presenting with an abdominal mass, rectal hemorrhage, or constipation.

What is Already Known:

- Intussusception can be managed without surgical intervention.
- Intussusception usually occurs in infants.

What This Study Adds:

- Identification of hydrostatic reduction failure risk factors in our setting.
- No serious complications occurred due to hydrostatic reduction.

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Author Contributions:

- SK: Drafting the article
- MT: Finalizing the manuscript
- AT: Conceptualizing the article

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