Childhood intussusception: Correlation between ultrasound reports and intra-operative findings

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Abstract

Background: Intussusception, a common cause of intestinal obstruction in children, is usually diagnosed through ultrasound scan. The aim of this study was to evaluate the correlation between the ultrasound report and intra-operating findings in children who had laparotomy for intussusception.

Materials and methods: This was a retrospective study of children aged 12 months and below who had laparotomy for intussusception between January 2017–December 2019 at the pediatric surgery unit of Enugu State University Teaching Hospital Enugu, Nigeria. Findings at ultrasound and findings at surgery were statistically compared.

Results: A total of 103 cases of intussusceptions were seen during the study period. Out of this number, 69 patients were treated by laparotomy and formed the basis of this report. There was male predominance and the median age of the patients was 8 months. Abdominal pain was the most common presenting symptom. At presentation, about one-quarter of the patients were anemic while one-half of the patients had electrolyte derangement. Comparing the findings at ultrasound and findings at surgery, ultrasound was found to have an accuracy of 89.9%. Approximately, equal number of patients had manual reduction and bowel resection. Surgical site infection was the most common post-operative complication and mortality occurred in 8 (11.6%) patients.

Conclusion: Ultrasound has high accuracy rate and is quite reliable for the diagnosis of intussusception.

Keywords

Accuracy, children, correlation, intussusception, ultrasound

Introduction

The invagination of one bowel segment into another segment is entitled intussusception. Childhood intussusception refers to invagination of the terminal ileum into the colon. Intussusception is a surgical emergency and one of the most common causes of intestinal obstruction in early childhood. Bowel invagination causes intestinal obstruction and the invaginating segment (intussusceptum) is carried distally by peristalsis. Transanal protrusion of the intussusception can occur when the intussusceptum passes through the anal opening. Most childhood intussusceptions are idiopathic, however, occasionally intussusception may be caused by a pathological lead point. Delays in presentation, diagnosis, and treatment of intussusception may result in vascular compromise and bowel gangrene. The typical clinical features of intussusception consist of intermittent colicky abdominal pain, abdominal mass, and passage of red currant jelly stool. However, these typical features are present in about 50% of the patients. Some of the symptoms of intussusception may be atypical and non-specific; therefore, there is a role for imaging investigation in the diagnosis of intussusception. Ultrasound is the imaging modality of choice because of its high sensitivity and specificity. Despite the high specificity of ultrasound, the confirmation of intussusception may still be missed at ultrasound. The reasons for the failure to confirm or exclude intussusception at ultrasound may vary from place to place and from one sonographer to another. Finding no intussusception at laparotomy is an unpleasant experience for the surgeon. Hence, the need for this study to evaluate our experience in the treatment of children that present with intussusception. The aim of this study was to evaluate...
the correlation between the ultrasound report and intra-operating findings in children who had laparotomy for intussusception.

Methods

This was a retrospective study of children aged 12 months and below who had laparotomy for intussusception between January 2017–December 2019 at the pediatric surgery unit of Enugu State University Teaching Hospital (ESUTH) Enugu, Nigeria. The age of 12 months was chosen because all of our patients in the current series were less than 12 months of age. ESUTH is a tertiary hospital located in Enugu, South East Nigeria. The hospital serves the whole of Enugu State, which according to the 2016 estimates of the National Population Commission and Nigerian National Bureau of Statistics, has a population of about 4 m people and a population density of 616.0/km². The hospital also receives referrals from its neighboring states. Patients with incomplete medical records and those who had successful hydrostatic reduction were excluded from the study. Patients who had successful hydrostatic reduction were also excluded from the study. Ethical approval was obtained from the Research and Ethics committee of ESUTH and patients’ caregivers gave consent for the study. This study followed the principles of the Declaration of Helsinki.

Pre-operative preparation

Recruitment into the study was based on clinical features suggestive of intussusception, ultrasound diagnosis of intussusception, failure of hydrostatic reduction, or features of peritonitis at presentation. Hydrostatic reduction was performed under ultrasound guidance and early presentation without features of peritonitis was the indication for hydrostatic reduction. However, only patients who had laparotomy for intussusception were considered in the present study. On arrival, the patients were resuscitated using intravenous fluids and antibiotics. Urethral catheter and nasogastric tubes were passed for monitoring urine output and gastrointestinal tract decompression respectively. The patients were taken to the ultrasound room for an ultrasound scan. The scan was performed by the radiologist on duty. Blood profile and serum electrolytes were done and any derangements were corrected. Grouping and crossmatching of blood was also performed. The procedure was explained to the parents and informed consent obtained. The patient was optimized and taken to theatre for surgery.

Intra-operative protocol

The surgical procedure was performed under general anesthesia by a consultant pediatric surgeon. Surgical access was through a transverse supra-umbilical incision. Presence or absence of intussusception was noted. The surgical procedures performed were manual reduction of the intussusception or bowel resection and anastomosis. The indications for bowel resection were gangrenous bowel and failure to achieve manual reduction of intussusception. At surgery, patients with confirmed intussusception were categorized as group A while patients with no intussusception were classified as group B.

Post-operative protocol

Intravenous fluids, antibiotics and analgesics were part of the post-operative management protocol. Feeds were commenced on return of bowel function. Adequate wound healing and good oral intake were the requirements for discharge from hospital.

Data collection and analysis

Data were collected including age of the patient at presentation, gender, duration of symptoms before presentation, finding at ultrasound, finding at surgery, treatment offered, post-operative complications, duration of hospital stay, and outcome of treatment. Group A and group B patients were compared.

Statistical Package for Social Science (SPSS) version 23, manufactured by IBM Cooperation Chicago Illinois, was used for data entry and analysis. Data were expressed as percentage, mean, and median.

Results

Patient demographics

A total of 103 cases with ultrasound diagnosis of intussusception were treated during the study period. Out of this number, 69 (67%) patients had laparotomy for the treatment of their intussusception and formed the basis of this report. The remaining 34 (33%) patients were treated non-operatively by hydrostatic reduction. Details of the demographics are shown in Table 1.

Clinical presentations

Abdominal pain was the most common symptom in our patients. Other clinical features are depicted in Table 2. The two groups of patients basically had similar symptoms.

Other investigations apart from ultrasound

Hematological and biochemical investigations. Nineteen (27.5%) patients had a hemoglobin level of less than 10 g/dl and there was hypokalemia in 39 (56.5%) patients.

Radiographs. Plain abdominal x-ray was performed in 16 (23.2%) patients. All of the abdominal x-rays showed features

| Table 1. Patient demographics. |
|--------------------------------|
| Gender | Male 52 (75.4%) |
|       | Female 17 (24.6%) |
| Median age of patients | 8 months (4–9 months) |
| Median duration of symptoms prior to presentation | 4 days (3–7 days) |
| Median duration from presentation to surgery | 2 days (1–3 days) |
| Mean duration of hospital stay | 10 days (7–15 days) |
of intestinal obstruction evidenced by dilated bowel loops and air fluid levels. Typical radiographic features of intussusception were not found on x-ray. Contrast studies were not performed.

**Ultrasound report and intra-operative findings**

All the 69 patients had an ultrasound report that said there was intussusception. However, 62 (89.9%) patients were confirmed to have intussusception at surgery (group A) while seven (10.1%) patients had no intussusception (group B). The features of intussusception were suggestive of intussusception which was ultrasound confirmed and served as the indication for laparotomy. Out of these seven patients, no pathology was found in two patients while five had bands causing intestinal obstruction. There were three radiologists involved in the ultrasound scanning of the patients. Two radiologists each misdiagnosed the intussusception in two patients while one radiologist misdiagnosed the intussusception in three patients. This gives an accuracy rate of 89.9% in the present study.

**Operative procedures performed**

Twenty-seven (27/62) (43.5%) patients had manual reduction whereas 35 (35/62) (56.5%) patients had right hemicolectomy with ileotransverse anastomosis. No pathological lead points were found at surgery.

**Post-operative complications**

Thirteen (18.8%) patients had surgical site infection, four (5.8%) patients developed anastomotic leak and two (2.9%) patients developed incisional hernia.

**Management outcome**

Sixty-five (94.2%) patients made a full recovery and were discharged home. Four (5.8%) patients expired. The cause of mortality was overwhelming sepsis.

**Discussion**

Intussusception represents one of the most common pediatric abdominal surgical emergencies. About 90% of intussusception in children is idiopathic and results from uncoordinated peristalsis or lymphoid hyperplasia which may be caused by viral infection. Imaging plays a major role in the diagnosis of intussusception. Ultrasound has been described to have a high negative predictive value of 100%. However, there are reports where the diagnosis of intussusception has been missed at ultrasound.

In the present study, about two-thirds of our patients were treated operatively through laparotomy. This finding is consistent with a report from Ibadan, Nigeria. One study from Tanzania reported that 100% of their patients were treated by laparotomy. However, another study from China reported laparotomy in only 10% of the patients in their series. The modality of treatment for children with intussusception may depend on the time of presentation and clinical state of the patient at presentation. Male predominance recorded in the present study is comparable to the report of other authors. However, Bartocci et al. in their series reported female predominance. The reason for the gender difference is not known. The peak age of our patients is similar to the reports of other studies. It is important to note that intussusception can occur at any age especially when there is a pathological lead point. Patients in low-income countries do not present early to the hospital due to poverty and lack of awareness. This may explain the delayed presentation of our patients. The two-day period between presentation and treatment was the time required to resuscitate, investigate, correct electrolyte derangements, and provide materials needed for surgery. The duration of hospitalization of our patients is in line with the reports of other researchers. However, a duration of stay as low as 25.6 h has been reported. The duration of hospital stay of children who presented with intussusception may depend on the method of treatment and definitive surgical procedure performed. The length of stay is longer in patients who underwent bowel resection.

Abdominal pain in intussusception is described as intermittent and colicky. It is a frequent symptom of intussusception due to attempts by the small bowel to overcome the obstruction. Studies from Chukwubuike and van den Ende et al. also reported abdominal pain as the most common symptom in their series. However, painless intussusception can occur in children who are less than 4 months of age. Non-specific symptoms such as lethargy, diarrhea, and vomiting may be the only manifestation of intussusception.

One-quarter of our patients were anemic at presentation. This was evidenced by hemoglobin level of less than 10 g/dl. Pre-existing anemia or passage of bloody stools by the patient may account for the anemia. Electrolyte derangement such as hypokalemia may be present in children with intussusception. Low oral intake, vomiting, and passage of mucus which is rich in electrolytes may explain the electrolyte imbalance. About one-quarter of our patients had a plain abdominal x-ray which showed dilated bowel loops and multiple air fluid levels. Plain x-rays for intussusception may not show any specific features of intussusception.

The accuracy rate of 89.9% recorded in the index study is comparable to the finding of Cina et al. However, this is at variance with the report of Usang et al. The differences in accuracy rate may be dependent on the expertise, experience,

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**Table 2. Clinical features of patients.**

|                        | Number of patients (%) |
|------------------------|------------------------|
|                        | Group A (n=62) | Group B (n=7) |
| Abdominal pain          | 24 (38.7)      | 6 (85.7)      |
| Vomiting               | 20 (32.3)      | 5 (71.4)      |
| Fever                  | 20 (32.3)      | 5 (71.4)      |
| Red currant jelly stool| 17 (27.4)      | 4 (57.1)      |
| Palpable abdominal mass| 10 (16.1)      | 2 (28.6)      |
| Nonspecific symptoms (e.g. lethargy) | 8 (12.9) | 1 (14.3) |
and exposure of the sonographer. Obesity and massive gaseous bowel distension may limit the accuracy of ultrasound in the detection of intussusception. There is the possibility of spontaneous reduction of the intussusception at induction of anesthesia for surgery.

About half of our patients had right hemicolectomy with ileotransverse anastomosis. Delayed presentation of the patients, with associated bowel gangrene, may explain this large number of patients that had bowel resections. Untimely presentation and late diagnosis and treatment gives room for interference with intestinal blood supply which leads to gangrene and perforation.

Surgical site infection was the most common post-operative complication recorded in this series. Similar studies also recorded surgical site infection as a common complication following laparotomy for intussusception. A study from Indonesia reported sepsis and preoperative hemoglobin levels as factors strongly associated with surgical site infection. The majority of our patients recovered well. However, the mortality rate in the present study was 11.6%. Other studies have also recorded comparable mortality rates. Mortality rates as high as 18.2% and 32% are reported in Nigeria and Uganda, respectively. However, a mortality rate as low as 2.2% has also been reported. Mortality following treatment for intussusception may depend on the state of the patient at presentation (complicated versus uncomplicated), treatment offered (manual reduction versus bowel resection), and post-operative complications.

Strength of the study
This study evaluated a surgical condition that cuts across two specialties: radiology and surgery. There is no data on the correlation between findings at ultrasound and at surgery in Enugu, Nigeria. Only patients who had laparotomy for intussusception were recruited, so there was no doubt about the presence of intussusception.

Weakness/limitations of the study
1. This series was limited by the small number of cases.
2. The ultrasound was performed by more than one radiologist and this may have introduced operator variability.

Conclusion
Ultrasound has a high accuracy rate and is quite reliable for the diagnosis of intussusception. However, some intussusceptions may be misdiagnosed during ultrasound scan. Sixty-nine patients who had laparotomy for intussusception were evaluated and ultrasound was found to have an accuracy rate of 89.9%. About 50% of patients had manual reduction of intussusception while another 50% of the patients underwent bowel resection.

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Author contribution
The authors alone took part in the formulation of the concept, data collection, data analysis, and interpretation of results.

Availability of data and materials
The datasets generated and/or analyzed during the current study are available from the corresponding author.

Conflict of interest
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