

# Diagnostic Accuracy of Ultrasonography in Diagnosis of Intussusceptions in Pediatric Patients

Ultrasonography  
in Diagnosis of  
Intussusceptions  
in Children

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## ABSTRACT

**Objective:** To determine the diagnostic accuracy of ultrasonography in diagnosis of intussusceptions in pediatric patients at a tertiary care hospital.

**Study Design:** Cross sectional study

**Place and Duration of Study:** This study was conducted at the Department of Diagnostic Radiology The Children's Hospital & the Institute of Child Health, Lahore from July 2022 to December 2022.

**Methods:** One hundred and twenty five consecutive patients younger than 6 years old participated in this study. Patients with symptoms such as blood in the stool and abdominal pain were screened using ultrasound by a trained radiologist. Radiological and surgical outcomes were accurately assessed by regularly monitoring patients. Statistics and data were SPSS 22 was used for the analysis.

**Results:** The mean age of patients was 1.75 years, with a standard deviation of 2.11 years. In terms of gender, 63.3% were male, while 36.7% were female. Clinical presentation revealed that abdominal pain was the most common, affecting 53.3% of patients, followed by vomiting (34.4%), bloody stools (8.0%), and fever (4.8%). In the assessment of intussusception in pediatric patients, ultrasound demonstrated the following diagnostic performance as sensitivity (91.95%), specificity (78.95%), positive predictive value (90.91%), negative predictive value (81.08%), and accuracy (88.0%).

**Conclusion:** Ultrasound was found to be 91.95% sensitive, 78.95% specific and 88.0% accurate in diagnosing intussusception in children which owing to its non-invasive and radiation free nature and bedside availability advocate its preferred use in future practice.

**Key Words:** Diagnostic Accuracy, Ultrasonography, Intussusceptions, Children, Surgery, Imaging

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## INTRODUCTION

When one section of the bowel invaginates into the next section, a condition known as intussusception occurs. Intussusception is more common in the small intestine than the large intestine. Abdominal pain, which may come and go, bloating, bloody faeces and vomiting are all possible symptoms.<sup>1,2</sup> Obstruction of the ileocecal valve is a possible outcome. Peritonitis and intestinal perforation are two more possible risks.

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In the US, EU, and AU, the annual incidence rate is between 3 to 40 per 10,000 live births on average.<sup>3</sup> In children, intussusception accounts for more than 90% of all cases. However, about 5% of cases have a pathological lead point, such as Meckel diverticulum, lymphoid hyperplasia, intestinal polyps, duplication cyst, lymphoma, mesenteric nodes, surgery or trauma. Intussusceptions can happen anywhere in the digestive tract, although the ileocolic and colonic types are the most common.<sup>4,5</sup>

Most cases of intussusception in children are of the ileocolic variety. In children, intussusception usually has an unknown cause, while anatomic and viral factors play a role. Endometriosis, intestinal adhesions, and intestinal tumour are all risk factors in adults.<sup>6</sup> Diagnosis is typically bolstered by medical imaging. Reduction of the intussusceptum non-surgically, employing air or contrast enemas as the modality of choice which is usually the first step in the diagnosis and treatment of this group.<sup>7</sup> Diagnosis is typically bolstered by medical imaging. When diagnosing a condition in a child, ultrasonography is the gold standard. Patients with only mild symptoms like nausea and vomiting are increasingly being admitted to

hospitals in recent years. As a result, a paediatric surgeon should determine whether to take the infant for an enema pneumatic reduction or close surveillance, with the verified diagnosis based primarily on ultrasound results. Acute intussusception has a success rate between 83% and 88%, making it difficult to decide between saline-enema and pneumatic reduction as a treatment.<sup>8,9</sup>

Morbidity occurs, especially because of delays in diagnosis and treatment. Conducting a study on the diagnostic accuracy of ultrasonography in pediatric intussusception diagnosis is essential due to the lack of local research in this critical area. Timely diagnosis is crucial in managing this condition, and regional factors may impact diagnostic performance. By assessing the effectiveness of ultrasonography within our specific healthcare context, we aim to provide valuable insights for local healthcare providers, potentially reducing diagnostic delays and improving patient outcomes. This research will contribute to advancing pediatric medical practice in our region, ultimately enhancing the quality of care for young patients with intussusception.

## METHODS

This cross-sectional study, with approval from the Research Ethics Committee was conducted on 125 consecutive patients at the Department of Diagnostic Radiology The Children's Hospital & the Institute of Child Health, Lahore from July 2022 to December 2022. All parental approval was obtained in written form. All hospital patients, both inpatients and outpatients, as well as those seen in the emergency room were included. Children of either sex younger than 6 years old who presented with the classic intussusception symptoms of colicky abdominal discomfort, vomiting, and red jelly stools were considered for inclusion. Excluded were those who had previously been diagnosed with intussusception via barium enema or CT scan, as well as those whose intussusception was reduced on barium enema.

We used a Toshiba Aplio ultrasound system (Toshiba, Tokyo, Japan) with 3.5 MHz and 8.0 MHz probes to capture the images. A senior attending radiologist with three years of experience took a series of longitudinal and transverse photographs and evaluated them. After surgery, all patients with irreducible intussusception symptoms were monitored, even those with free fluid or no blood flow on colour Doppler. In addition, we considered patients when barium enema was unsuccessful in reducing the intussusception and surgery was the only option left. The results of the patients' tests, whether positive or negative, were recorded on the attached proforma. Intussusception cases confirmed by ultrasound were surgically corrected, and the outcomes were documented. Patients whose ultrasounds came back negative were observed, and if another scan the following day showed no

intussusception, they were given only conservative care and sent home.

SPSS having Version 22.0 was used for data collection and analysis on the patients. The average and standard deviation for the ages of the patients were shown. Using surgical findings as the gold standard, negative and positive predictive values of ultrasonography for diagnosing intussusceptions were estimated after data analysis, sensitivity, and specificity were determined. Post-stratification Ultrasound's sensitivity, specificity, and positive and negative predictive values were calculated using Surgery as the gold standard in a 2x2 table.

## RESULTS

The mean age of patients was 1.75 years, with a standard deviation of 2.11 years. The age distribution showed that 33.3% of patients were in the 0-1 years range, 46.7% in the 1-3 years range, and 20.0% in the 3-6 years range. In terms of gender, 63.3% were male, while 36.7% were female. Clinical presentation revealed that abdominal pain was the most common, affecting 53.3% of patients, followed by vomiting (34.4%), bloody stools (8.0%), and fever (4.8%) as shown in table 1. In the ultrasound category, 88 patients (70.4%) tested positive for intussusception, while 37 patients (29.6%) tested negative. On the other hand, in the surgery category, 80 patients (64.0%) were diagnosed as positive for intussusception, while 45 patients (36.0%) were diagnosed as negative. These findings indicate that the majority of patients tested positive for intussusception in both ultrasound and surgery modalities, with slightly higher percentages in the ultrasound group (70.4%) compared to the surgery group (64.0%) as shown in table 2.

**Table No. 1: Demographics Data age, gender and presenting complaints of study sample**

Variables	Characteristics	No. of Patients	%age
Age	Mean $\pm$ SD	1.75 $\pm$ 2.11	-
	0-1 years	41	33.3%
	1-3 years	58	46.7%
	3-6 years	25	20.0%
Gender	Male	79	63.3%
	Female	46	36.7%
Clinical Presentation	Abdominal Pain	66	53.3%
	Vomiting	43	34.4%
	Bloody Stools	10	8.0%
	Fever	06	4.8%

Table 3 displays a 2x2 contingency table assessing the diagnostic accuracy of ultrasound in detecting intussusception in children. Among the 125 patients, ultrasound correctly identified intussusception in 80 cases (True Positives) but erroneously suggested its

presence in 8 cases (False Positives). In the assessment of intussusception in pediatric patients, ultrasound demonstrated the following diagnostic performance metrics as depicted in Table 4, sensitivity (91.95%), specificity (78.95%), positive predictive value (90.91%), negative predictive value (81.08%), and accuracy (88.0%).<sup>14,15</sup>

**Table No. 2: Diagnosis of intussusception on ultrasound & surgery**

Modality	Intussusception	Frequency	(%)
Ultrasound	Positive	88	70.4
	Negative	37	29.6
	Total	125	100.0
Surgery	Positive	80	64.0
	Negative	45	36
	Total	125	100.0

**Table No. 3: 2x2 Contingency table to determine diagnostic performance of ultrasound in diagnosing Intussusception in children**

Intussusception on US	Intussusception on Surgery		Total
	Positive	Negative	
Positive	80 (TP)	08 (FP)	88
Negative	07 (FN)	30 (TN)	37
Total	80	45	125

**Table No. 4: The diagnostic precision of sonography in the evaluation of suspected intussusception among pediatric patients, using surgical findings as the reference standard**

Statistic	Formula	Value
Sensitivity	$\frac{a}{a+b}$	91.95%
Specificity	$\frac{d}{c+d}$	78.95%
Accuracy	$\frac{a+d}{a+b+c+d}$	88.0%
Disease prevalence	$\frac{a+b}{a+b+c+d}$	37.86%
Positive Predictive Value	$\frac{a}{a+c}$	90.91%

## DISCUSSION

The reliability of ultrasonography in identifying intussusception has been contested by radiologists, despite the fact that it is accurate and more cost-effective than other diagnostic modalities for intussusception. It has been noted that intussusception is the most prevalent abdominal emergency in young children and is the second-most prevalent cause of intestinal obstruction, following pyloric stenosis.<sup>10</sup>

In this study mean age of the enrolled children was 1.75±2.11 years and 63.3% were male and 43.2% were patients. Our results of children age and gender were in accordance with Gul et al. The average age of the participants in the Gul et al. (2016) study in which

mean age was 2.3±1.4 years and 56.8% were male and 43.2% female patients.<sup>11</sup> Clinical presentation revealed that abdominal pain was the most common, affecting 53.3% of patients, followed by vomiting (34.4%), bloody stools (8.0%), and fever (4.8%) are in line with findings of Shuaib et al. (2022)<sup>12</sup> who reported that intussusception can manifest itself in a number of different ways clinically, but it is always accompanied by stomach discomfort and other symptoms of bowel obstruction. Similar clinical presentations are reported by Gul et al. (2016) abdominal pain in 85 (44.3%) patients, vomiting in 30 (15.6%), and abdominal mass in 16 (18.2%).<sup>13</sup>

In our study, on ultrasound examination 88(70.4%) found positive for intussusception as compared to 80 patients (64.0%) were diagnosed as positive on surgery. These are comparable with findings of Gul et al. (2016) that ultrasound examination led to the diagnosis of intussusception in 33 patients (Graph-1), while surgical intervention revealed the condition in 31 patients.<sup>13</sup> In our study sensitivity (91.95%), specificity (78.95%), positive predictive value (90.91%), negative predictive value (81.08%) and accuracy were (88.0%). Our findings are similar with study by Gul et al.(2016).<sup>13</sup> in which overall sensitivity, specificity, and accuracy of ultrasonography for the diagnosis of intussusception were 83.9%, 95.7%, and 93.7%, respectively. Overall internationally, ultrasonography has been shown to have a sensitivity of 85% to 100% and a specificity of 88% to 100% when diagnosing intussusception in adults, whereas in children, these figures are 94.94%, 97.06%, and 95.57%.<sup>14,15,16,17,18</sup>

Ultrasonography is a reliable, safe, and effective tool in confirming the presence of acute intussusception in children. The morbidity associated with a late diagnosis can be reduced with early surgical intervention, which can be facilitated by USG. If ultrasonography is used as a first screening test for intussusception, the patient will be exposed to less radiation from unneeded contrast-based enemas. If the ultrasonography results are good, a contrast enema will be necessary as well, which could increase the total cost.<sup>19</sup>

Our results may potentially be limited because all of our attending physicians were paediatricians and because we only analysed data from a single centre. Last but not least, intussusception may have been present but was misdiagnosed since it resolved on its own prior to any intervention, such as an air enema.

## CONCLUSION

In the diagnosis of acute intussusception in children, ultrasonography is reliable, safe, and useful. Ultrasound was found to be 91.95% sensitive, 78.95% specific and 88.0% accurate in diagnosing intussusception in children which owing to its non-invasive and radiation free nature and bedside availability advocate its preferred use in future practice.

**Author's Contribution:**

Concept & Design of Study: Rabia Aqeel  
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