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ROLE OF ULTRASONOGRAPHY AS A PRIMARY DIAGNOSTIC TOOL IN PEDIATRIC INTUSSUSCEPTION: CORRELATION WITH SURGICAL FINDINGS

Original Research

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ABSTRACT

Background: Intussusception is a leading cause of acute abdominal emergencies in children, particularly between the ages of 6 months and 2 years. If not diagnosed and managed promptly, it can lead to serious complications including bowel ischemia, necrosis, and death. Among the available diagnostic tools, ultrasonography has emerged as a non-invasive and accessible imaging modality. This study aimed to evaluate the diagnostic accuracy of ultrasound in identifying intussusception in pediatric patients by comparing sonographic findings with surgical outcomes.

Objective: To evaluate the accuracy of ultrasound in the diagnosis of intussusception in children.

Methods: A prospective, cross-sectional study was conducted in the Department of Radiography and Imaging Technology at Al-Razi Institute, Lahore, from December 2024 to May 2025. After obtaining ethical approval, a total of 310 children aged between 6 months and 5 years, clinically suspected of having intussusception, were enrolled. Exclusion criteria included patients with previous abdominal surgeries or those unfit for surgical intervention. Each patient underwent an abdominal ultrasound performed by an experienced radiologist using a Toshiba Xario 100 ultrasound machine. Final diagnosis was confirmed by follow-up surgical findings. Diagnostic metrics including sensitivity, specificity, predictive values, and overall accuracy were calculated.

Results: Of the 310 patients, 189 were male (61%) and 121 were female (39%). Ultrasonography detected intussusception in 260 cases (83.87%), while surgery confirmed 285 cases (91.93%). Ultrasound demonstrated a sensitivity of 95.51%, specificity of 45.97%, positive predictive value of 81.92%, negative predictive value of 80.00%, and overall diagnostic accuracy of 81.61%.

Conclusion: Ultrasound proved to be a highly sensitive and moderately specific diagnostic modality for detecting intussusception in children, supporting its continued use as a first-line imaging technique in pediatric abdominal emergencies.

Keywords: Abdominal Pain, Child, Diagnostic Imaging, Intussusception, Pediatrics, Sensitivity and Specificity, Ultrasonography.

INTRODUCTION

Intussusception is a serious medical condition characterized by the invagination of one segment of the intestine into another, often likened to a telescoping mechanism. This pathological folding can lead to intestinal obstruction, compromising the passage of food and reducing blood flow to the affected gut segment, which may result in ischemia, necrosis, or even gangrene if left untreated (1,2). The progressive inflammation and swelling from the obstruction can further escalate to generalized peritonitis, a life-threatening complication (3). If timely diagnosis and treatment are not initiated, the condition may prove fatal (4,5). Although intussusception can occur at any age, it predominantly affects the pediatric population, particularly between the ages of 6 months and 2 years, with occasional incidence in older children (6,7). It accounts for approximately 7–8% of cases presenting with compatible gastrointestinal symptoms in this age group (8). The etiology of intussusception remains idiopathic in nearly 90% of pediatric cases, where no underlying cause can be identified. However, secondary intussusception may occur due to identifiable pathological lead points such as Meckel's diverticulum or intestinal tumors (9,10). Given its potential for rapid progression and severe outcomes, early recognition of intussusception is essential. In recent years, ultrasonography has emerged as a frontline diagnostic modality due to its high sensitivity (83.9%) and specificity (95.7%) for detecting intussusception (11,12).

Unlike traditional barium enema, ultrasonography is non-invasive, devoid of radiation exposure, and well tolerated by children. Moreover, it is readily available, cost-effective, and provides real-time evaluation without discomfort. The addition of Color Doppler imaging enhances diagnostic capability by assessing vascular flow and identifying ischemic changes, as well as detecting possible pathological lead points or excluding alternative causes of bowel obstruction. Despite these advantages, the adoption of ultrasonography as a first-line diagnostic tool is not yet universal, often delayed by a lack of awareness or access in some clinical settings. Therefore, there is a pressing need for reliable, non-invasive, and widely applicable diagnostic strategies to identify intussusception at an early stage, thereby reducing the associated morbidity and mortality. The present study aims to evaluate the diagnostic accuracy of ultrasonography in the early detection of acute intussusception in children. It seeks to establish ultrasound as a preliminary diagnostic standard that ensures timely intervention, improves clinical outcomes, and enhances the overall safety and efficiency of pediatric care.

METHODS

This cross-sectional study was conducted at the Department of Radiography and Imaging Technology, Al-Razi Institute, Lahore, over a six-month period from December 2024 to May 2025, following approval from the institutional ethical review committee. A total of 310 pediatric patients, aged between 6 months and 5 years, were enrolled based on non-probability consecutive sampling. Inclusion criteria comprised children clinically suspected of intussusception, typically presenting with symptoms such as abdominal pain, distension, and passage of blood or "currant jelly" stools. Exclusion criteria included patients with prior abdominal surgeries for unrelated conditions and those deemed unfit for surgical intervention, as such histories could confound ultrasound findings or impact the natural presentation of intussusception (13,14). Initial clinical evaluation was performed by pediatricians, who referred suspected cases to the Radiology Department for further assessment. All ultrasound examinations were performed by an experienced radiologist using a Toshiba Xario 100 ultrasound machine equipped with a high-frequency linear transducer.

Standard scanning protocols were followed, including transverse and longitudinal views of the abdomen to detect the characteristic "target" or "doughnut" sign. Written informed consent was obtained from parents or guardians prior to scanning, in accordance with ethical standards. Ultrasound results were categorized as either positive or negative for intussusception. Patients were subsequently observed and managed either conservatively or surgically, allowing for correlation of imaging findings with final clinical outcomes to confirm true positives and true negatives. Radiologists and pediatric surgeons monitored these cases closely throughout their hospital stay to ensure diagnostic accuracy. Data were entered and statistically analyzed using IBM SPSS version 25. Frequencies, percentages, sensitivity, specificity, and predictive values were calculated to evaluate the diagnostic performance of ultrasound. No major statistical anomalies were identified during data processing.

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RESULTS

A total of 310 pediatric patients suspected of having intussusception were included in the study. The mean age of the sample was 2.9 ± 1.4 years, with age ranging from 0.5 to 5 years. Among these, 61% were male and 39% were female, reflecting a male predominance in the study population. Ultrasonographic evaluation revealed that 260 out of 310 patients (83.87%) were positive for intussusception, while 50 patients (16.13%) showed no evidence of the condition on initial ultrasound. In contrast, surgical follow-up confirmed intussusception in 285 patients (91.93%), whereas 25 cases (8.06%) were determined to be negative during intraoperative assessment. Comparison of ultrasound findings with surgical confirmation showed that out of the 260 ultrasound-positive cases, 213 were true positives and 47 were false positives. Among the 50 ultrasound-negative cases, 10 were false negatives while 40 were true negatives. Based on this comparison, ultrasonography demonstrated a sensitivity of 95.51%, a specificity of 45.97%, a positive predictive value of 81.92%, and a negative predictive value of 80.00%. The overall diagnostic accuracy of ultrasonography for detecting intussusception was calculated to be 81.61%.

Table 1: Frequency of Intussusception on USG (n=310)

Intussusception on USG	Frequency	Percentage
Positive	260	83.87%
Negative	50	16.13%
Total	**310**	**100%**

Table 2: Frequency of Intussusception on Surgery (n=310)

Intussusception on Surgery	Frequency	Percentage
Positive	285	91.93%
Negative	25	8.06%
Total	**310**	**100%**

Table 3: Frequency of Intussusception on USG + Surgery (n=310)

Intussusception on USG	Intussusception on Surgery		Total
	Positive	Negative	
Positive	213	47	260
Negative	10	40	50
Total	**223**	**87**	**310**

Table 4: The Diagnostic Performance Metrics of Ultrasound in Detecting Intussusception

Metric	Value (%)
Sensitivity	95.51
Specificity	45.97
Positive Predictive Value (PPV)	81.92
Negative Predictive Value (NPV)	80.00
Accuracy	81.61

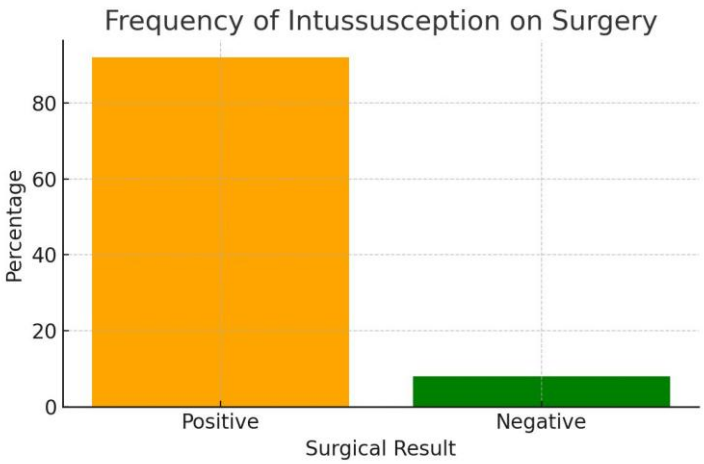

Figure 1 Frequency of Intussusception on Surgery

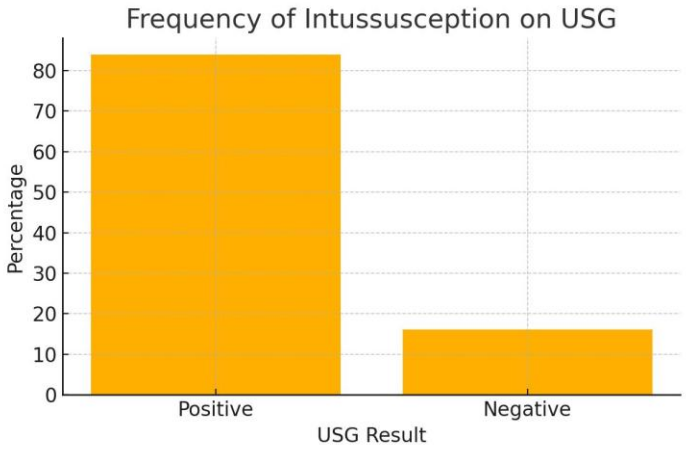

Figure 2 Frequency of Intussusception on USG

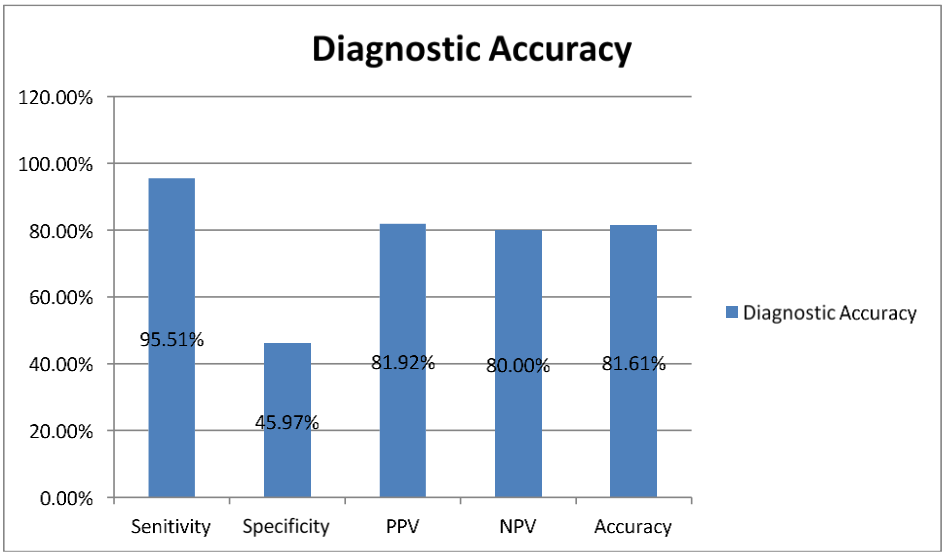

Figure 3 Diagnostic Accuracy

DISCUSSION

Intussusception remains a significant cause of acute abdominal emergencies in pediatric populations, ranking second only to pyloric stenosis as a cause of intestinal obstruction in infancy and being the most common surgical emergency in early childhood (15). The present study reaffirms existing epidemiological patterns, with a higher incidence in males and a peak age range of 6 to 18 months. The condition was notably less common in children older than two years, aligning with prior reports that only 30% of cases involve toddlers beyond this age group. Ileocolic intussusception was the most frequently encountered type in children, which is consistent with established literature. The study further emphasized infectious etiologies, particularly those involving mesenteric lymphadenopathy, as common contributing factors. Viral pathogens such as rotavirus and adenovirus are frequently associated with Peyer patch hypertrophy, which can serve as a pathological lead point (16-18). Despite these associations, most pediatric intussusceptions remain idiopathic, with only 10% of cases attributed to an identifiable lesion or trigger. Clinically, the variable presentation continues to challenge early diagnosis, especially when the classic triad—abdominal pain, palpable mass, and bloody stools—is present in fewer than 15% of cases

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(19,20). In this study, patients often presented with colicky abdominal pain, irritability, vomiting, and at times, currant jelly stools, reinforcing the need for high clinical suspicion in ambiguous cases.

Ultrasonography, owing to its non-invasive nature and diagnostic speed, maintained its role as the frontline imaging modality. The study demonstrated a high sensitivity of 95.51% and moderate diagnostic accuracy of 81.61%, affirming ultrasound as a reliable screening tool for intussusception, even in settings with limited resources. These results are consistent with global data validating ultrasound's superiority over other diagnostic approaches due to its ability to visualize the “target” or “doughnut” sign. However, certain factors—such as intestinal distension and morbid obesity—have been known to reduce the diagnostic yield of ultrasound by obscuring image quality and anatomical detail (21,22). The diagnostic value of ultrasound, even in less experienced hands, was evident in this study. Nonetheless, the accuracy and confidence in diagnosis significantly improved when scans were performed by skilled radiologists, suggesting the importance of training and experience in enhancing diagnostic precision. The findings support ultrasound as an essential tool, particularly in low-resource settings where rapid decisions are required and advanced imaging or fluoroscopy may be unavailable. However, in developing countries, limitations such as poverty, lack of operator expertise, and the unavailability of air or hydrostatic enema for non-operative reduction often necessitate surgical intervention. In such contexts, early and accurate diagnosis via ultrasound plays a pivotal role in reducing delays and avoiding severe complications (22).

A major strength of this study lies in its relatively large sample size and the prospective evaluation of ultrasound performance against surgical confirmation. The findings provide robust support for integrating ultrasound into standard diagnostic protocols for suspected intussusception. However, one limitation of the study is the absence of stratified analysis based on variables such as age, sex, or symptom duration, which may offer deeper insights into diagnostic variability. Furthermore, the exclusion of patients unfit for surgery may introduce selection bias, potentially overestimating diagnostic accuracy by omitting more complex or atypical cases. Future studies should focus on broader inclusion criteria, multicenter collaboration, and operator variability in scan interpretation. Evaluating the role of adjunct modalities like Color Doppler for ischemia detection and exploring ultrasound-guided hydrostatic reduction could further enhance non-operative management approaches. The current findings underscore the clinical value of early ultrasonographic evaluation in suspected intussusception and highlight the necessity of training radiologists and clinicians to recognize subtle sonographic features to improve diagnostic outcomes.

CONCLUSION

In conclusion, the study highlighted the value of ultrasonography as a reliable, non-invasive, and accessible diagnostic tool for the early detection of intussusception in infants and young children. Its ability to identify characteristic signs with considerable accuracy reinforces its role as a first-line imaging modality in pediatric abdominal emergencies. By enabling timely diagnosis and guiding prompt intervention, ultrasound significantly contributes to improving patient outcomes and reducing the risk of complications. The findings support its integration into routine clinical practice, while also emphasizing the need for continued research and training to further optimize its diagnostic utility in diverse healthcare settings.

AUTHOR CONTRIBUTION

Author	Contribution
Noor Fatima	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Ahmad Raza*	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Faiqa Saleem	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Muhammad Tayyab	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Sania Shabir	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Aqsa Kanwal	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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REFERENCES

1. Vakaki M, Sfakiotaki R, Liasi S, Hountala A, Koutrouveli E, Vraka I, et al. Ultrasound-guided pneumatic reduction of intussusception in children: 15-year experience in a tertiary children's hospital. Pediatr Radiol. 2023;53(12):2436-45.
2. Salman R, Seghers VJ, Schiess DM, Nguyen HN, Sher AC, Mertiri L, et al. Ultrasound imaging of bowel obstruction in infants and children. Radiol Med. 2024;129(8):1241-51.
3. Nguyen HN, Kulkarni M, Jose J, Sisson A, Brandt ML, Sammer MBK, et al. Ultrasound for the diagnosis of malrotation and volvulus in children and adolescents: a systematic review and meta-analysis. Arch Dis Child. 2021;106(12):1171-8.
4. Nguyen HN, Navarro OM, Bloom DA, Feinstein KA, Guillerman RP, Munden MM, et al. Ultrasound for Midgut Malrotation and Midgut Volvulus: AJR Expert Panel Narrative Review. AJR Am J Roentgenol. 2022;218(6):931-9.
5. Youssfi M, Goncalves LF. Ultrasound for malrotation and volvulus - point. Pediatr Radiol. 2022;52(4):716-22.
6. Li XZ, Wang H, Song J, Liu Y, Lin YQ, Sun ZX. Ultrasonographic Diagnosis of Intussusception in Children: A Systematic Review and Meta-Analysis. J Ultrasound Med. 2021;40(6):1077-84.
7. Jiang Z, Feng A. Small-Bowel Intussusception in a Child. N Engl J Med. 2024;390(21):2010.
8. Shen AW, Kothari A, Flint A, Kumar S. Prenatal imaging features and perinatal outcomes of foetal volvulus-A literature review. Prenat Diagn. 2022;42(2):192-200.
9. Plut D, Phillips GS, Johnston PR, Lee EY. Practical Imaging Strategies for Intussusception in Children. AJR Am J Roentgenol. 2020;215(6):1449-63.
10. Meister M, Alharthi O, Kim JS, Son JK. Pediatric emergency gastrointestinal ultrasonography: pearls & pitfalls. Clin Imaging. 2020;64:103-18.
11. Rong K, Herbst MK. Massive Ovarian Cyst Mimics Constipation. J Emerg Med. 2022;62(6):e108-e10.
12. Sullivan GA, Skertich NJ, Jones KB, Williams M, Gulack BC, Shah AN. An Infant with COVID-19-Associated Intussusception. Am Surg. 2023;89(11):4921-2.
13. Liu C, Du LN, Zhao Q, Wang XT, Feng K, Yang Y, et al. Immunoglobulin A Vasculitis With Intussusception in Children. Am Surg. 2024;90(6):1298-308.
14. Hom J, Kaplan C, Fowler S, Messina C, Chandran L, Kunkov S. Evidence-Based Diagnostic Test Accuracy of History, Physical Examination, and Imaging for Intussusception: A Systematic Review and Meta-analysis. Pediatr Emerg Care. 2022;38(1):e225-e30.
15. Yang L, Chen H, Lv G, Li F, Liao J, Ke L. Evaluation of ultrasonography in fetal intestinal malrotation with midgut volvulus. Ginekol Pol. 2022;93(4):296-301.
16. Ali A, Farooq M, Javed H, Burki S, Khan UN. DIAGNOSTIC ROLE OF ULTRASONOGRAPHY FOR INTUSSUSCEPTION IN CHILDREN. J Ayub Med Coll Abbottabad. 2024;36(3):606-10.
17. Lin-Martore M, Firnberg MT, Kohn MA, Kornblith AE, Gottlieb M. Diagnostic accuracy of point-of-care ultrasonography for intussusception in children: A systematic review and meta-analysis. Am J Emerg Med. 2022;58:255-64.
18. Marks A, Hartrich M, Colla J, Gottlieb M. Current Applications of Pediatric Abdominal Point-of-Care Ultrasound. Pediatr Ann. 2021;50(10):e419-e23.
19. Yan Q, Xu L, Chao J, Zhang Z, Wang H. Characteristics of intestinal-related lymphoid hyperplasia in children and its correlation with intussusception of children. BMC Pediatr. 2022;22(1):641.
20. Al Jobeer H, Al Dossari M, Babic I. Association between fetal echogenic and/or dilated bowel and adverse perinatal outcomes. Pediatr Int. 2023;65(1):e15496.
21. Zhang M, Zhou X, Hu Q, Jin L. Accurately distinguishing pediatric ileocolic intussusception from small-bowel intussusception using ultrasonography. J Pediatr Surg. 2021;56(4):721-6.
22. Bergmann KR, Khant M, Lammers S, Arroyo AC, Avendano P, Chaudoin L, et al. Accuracy and Interrater Reliability of Point-of-Care Ultrasonography Image Interpretation for Intussusception. Pediatr Emerg Care. 2022;38(9):442-7.