Original Article

Screening and Diagnosis of Pediatric Intussuseption

Diagnosing Pediatric Intussusception: Reliability of Sonographic Findings in Comparison to Operative Findings - A Short Term Analysis in Two Tertiary Care Hospitals

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ABSTRACT

Objective: To review the reliability of ultrasonography for the screening and diagnosis of intussusception in clinically suspected children examined in radiology departments of two tertiary care hospitals in comparison to operative findings.

Study Design: Cross-sectional study.

Place and Duration of Study: The study was conducted collaboratively in the Departments of Radiology, Pakistan Railway General Hospital, Rawalpindi and Bahawal Victoria Hospital, Bahawalpur from January 2013 to December 2014.

Materials and Methods: A total of 113 children with age ranging from 0-5 years of both gender having clinical features of suspected intussusception were included in the study. Patients with stomas, history of previous surgery, patients with known congenital intestinal anomalies and haemodynamically unstable patients were excluded. All these patients had undergone ultrasound of abdomen and pelvis. The sonographic findings were recorded as positive and negative for intussusception. The criteria for positivity included the "target or doughnut sign" on transverse view and the "pseudo kidney sign" in longitudinal view respectively. Subsequently all these patients underwent exploratory laparotomy and intra-operative findings were recorded and correlated with sonogaphic findings to determine diagnostic reliability of ultrasonography.

Results: Ultrasonography supported the diagnosis of intussusception in 76 (67.26%) patients. Operative findings confirmed intussusception in 79 (69.91%) cases whereas 34 (30.01%) patients revealed no intussusception. There was one false positive and four false negative results on ultrasonography. The sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of grey scale ultrasonography in intussusception in children were 94.94%, 97.06%, 98.68%, 89.19% and 95.57% respectively.

Conclusion: The sensitivity and specificity of sonographic findings for screening and diagnosing the intussusception as reported by the Radiology Departments of the two hospitals and confirmed with operative findings, were consistent with previous studies published locally and internationally.

Key Words: Intussusception, Children, Ultra-sonography, Screening, Diagnosis, Railway Hospital

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INTRODUCTION

Intussusception (IS) is one of the most common acute abdominal emergencies among infants and small children, particularly in children younger than 2 years of age, and the second most common cause of intestinal obstruction after pyloric stenosis.[1]

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Historically, after more than three hundred years its first description of the disease, the sonographic features of intussusception were explained in 1977 by Burke and Clark.[2] In 1982 by Kim first described the ultrasound-guided hydrostatic reduction of ileocolic intussusception using normal saline.[3]

Intussusception can be diagnosed by history, clinical findings and imaging studies. An early diagnosis and treatment of this disease are very important.[4,5] The frequently described clinical triad of intussusception consists of (a) acute colicky abdominal pain, (b) ''currant jelly'' or frankly bloody stools, and (c) either a palpable abdominal mass or vomiting, however, many children do not present with the complete triad of symptoms and in some cases the condition may be transient with spontaneous reduction.[5,6,7] Many children instead present with non-specific symptoms like vomiting, excessive crying or lethargy,. etc. and the diagnosis initially may be missed.[8,9] Up to 20% of

children having the condition may be pain free at the time of diagnosis.[10] Intussusception is actually found in 30%–68% of children with suspicious clinical findings.[11] Therefore, imaging studies are required to establish the a prompt and accurate diagnosis.[1,4,7,12]

The imaging studies including contrast studies (barium enema, air enema), computed tomography, gray scale ultrasound and Colour Doppler, etc. are available[3]. However, with improved scanning technology, high resolution ultrasonography is now the initial imaging investigation of choice for diagnosing the intussusception in children, being cost effective, portable, rapid, flexible, user- patient- and parent-friendly, free from hazards of ionizing radiations, and the ability to arrive at alternative diagnoses and also to predict the possibility and to provide guidance for non-operative enema reduction.[1,4,11,12,14,15,16] Published data suggest that in the experienced hands ultrasonography is considered the criterion standard for the diagnosis of intussusception, with both high sensitivity (98% to 100%) and specificity (88% to 100%).[4,17,18]

With this background we found only a few Pakistani studies on the subject.[19,20,21]. This study reports our hospital based experience at ultrasound diagnosis of intussusception in small children The rationale of our study is to review the reliability of ultrasonography for the screening and diagnosis of intussusception in clinically suspected children as practiced in our part of the world by analyzing the diagnostic yield in radiology departments of two tertiary care hospitals and comparing it with operative findings.

MATERIALS AND METHODS

This is a hospital based cross-sectional study carried out collaboratively at two centers, Departments of Radiology, Pakistan Railway General Hospital, Rawalpindi and Bahawal Victoria Hospital, Bahawalpur from January 2013 to December 2014. Children with age ranging from 0-5 years of both gender having clinical features of suspected intussusception as per operative definition for 0 to 5 days duration were included in the study. The exclusion criteria comprised patients with history of previous surgery; with stomas; who were managed non-operatively, haemodynamically unstable patients, and patients with known congenital intestinal anomalies. We examined 113 patients in the study presented in the Department of Radiology for USG abdomen. Our hospitals followed the World Medical Association Declaration from Helsinki in all the procedures. All the patients' parents were informed about the USG examination and surgery. Verbal consent was obtained for US examinations and written informed consent was obtained before surgery. After taking proper history and duration of presenting complaints, general data including age and sex was collected. Then trans-abdominal ultrasound examination of the patients with clinical suspicion of intussusception was carried out.

The ultrasound examination was performed using Siemens Sonoline G50 colour Doppler and GE Logic P-5 colour Doppler ultrasound machines with probes frequencies ranging from 2 to 11 MHz. Grey scale USG of entire abdomen including the pelvis was performed in all patients. The sonographic findings were recorded as positive and negative for diagnosis of intussusception. The criteria for positivity included visualization of "doughnut or target sign" in transverse section, ''bowel-within-bowel'' or "sandwich" or ''pseudo-kidney sign" in longitudinal section, of three overlapping layers of distal segment intussuscipiens and proximal segment intussusceptum), ''crescent-sign'', the trapped free fluid (indication for surgery). The presumptive ultrasound diagnosis of intussusception was made when the above described sonographic signs were recorded.[1,5,14,22] The criteria for negativity were non-visualization of sonographic signs or visualization of normal gut. All these patients underwent exploratory laparotomy after ultrasound examination. All the patients included in our study we investigated in collaboration with the department of surgery. Intra-operative findings were recorded. The definitive diagnosis of intussusceptions was confirmed in all those patients who had shown a mass of gut having invagination of the proximal segment of intestine into the adjacent distal segment on naked eye examination during the surgery.

The collected data were compiled and analyzed using SPSS version 19.00 for Windows. Descriptive statistics were calculated. The qualitative data, i.e., age and gender, presenting complaints, sonographic findings and operative findings for intussusception were presented as frequency distribution and percentage. Quantitative data, i.e., age (in years) and duration of symptoms (in days) were presented as mean and ±standard deviations. The results were presented as tables, pie chart and bar diagram.

RESULTS

Present study included 113 children that fulfilled the inclusion and exclusion criteria in the study period of 2 years. Age range in this study was from 0 to 5 years with mean age of 01 ± 1.15 years. Majority of the patients 71.68% were between 0 to 2 years of age and 39.82% were younger than 1 year, as shown in Table-1. Out of the total, 78 (69.02%) were male and 35 (30.98%) were females with male to female ratio of 2.2:1.

Majority of patients 51.33%and 46.02% presented with bilious vomiting and intermittent screaming (abdominal pain) respectively followed by stool mixed with mucous and blood, palpable abdominal mass, abdominal distention and constipation as shown in Table-2.

All the patients ultrasonography of the abdomen was done. Ultrasound supported the diagnosis of intussusception in 76 (67.26%) patients and operative findings confirmed intussusception in 79 (69.91%) as shown in Table-3.

Table No.1: Age wise distribution of patients

(n = 113)	Male		Female		Total.	
*Age (Yrs)	Number	Percentage	Number	Percentage	Number	Percentage
0-1	29	25.66	16	14.16	45	39.82
>1- 2	26	23.01	10	08.85	36	31.86
>2- 3	12	10.62	05	04.42	17	15.04
>3- 4	05	04.42	03	02.66	08	07.08
>4- 5	06	05.31	01	00.88	07	06.19
Total	78	69.02	35	30.98	113	100.0

*Age as at last birthday

Table No.2: Percentage distribution based on presenting complaints (n = 113)

Presenting Complaints*	No. of Patients	Percentage (%)
Bilious Vomiting	58	51.33
Intermittent Screaming (Abdominal Pain)	52	46.02
Stool mixed with mucous & blood	39	34.51
Palpable Abdominal Mass	37	32.74
Abdominal Distention	31	27.43
Constipation	27	23.89

*Patients presented with two or more presenting complaints

Table No.3 Diagnostic accuracy of Ultrasound findings in comparison to operative findings for diagnosing clinically suspected intussusception

(n=113)	Frequency	Operative Findings		Total
		Present	Absent	
Ultrasound Findings	Positive	75 (66.37%)*	01 (0.88%)**	76 (67.26%)
	Negative	04 (3.54%)***	33 (29.20%)****	37 (32.74 5)
Total		79 (69.91%)	34 (30.09%)	

* True positive ** False positive ***False negative ****True negative

Table No.4: Percentage of patients with Intussusception based on Age groups and Gender

(n = 79)	Male		Female		Total.	
*Age (Yrs)	Number	Percentage	Number	Percentage	Number	Percentage
0-1	26	32.91	14	17.72	40	50.63
>1- 2	20	25.32	06	7.59	26	32.91
>2- 3	05	6.33	02	2.53	07	8.86
>3- 4	04	5.06	01	1.27	05	6.33
>4- 5	01	1.27	00	0.0	01	1.27
Total	56	70.89	23	29.11	79	100.0

Table No.5: Overall reliability ultrasonography for diagnosing in intussusception

Evaluation of Ultrasonography	Values(%)
Sensitivity	94.94
Specificity	97.06
Positive Predictive Value (PPV)	98.68
Negative Predictive Value (NPV)	89.19
Diagnostic Accuracy	95.57
Likelihood ratio for Positive test result	32.28
Likelihood ratio for Negative test result	0.52

Sensitivity: TP / TP + FN Specificity: TN / TN + FP
Positive Predictive Value (PPV): TP / TP + FP
Negative Predictive Value (NPV): TN / TN + FN

In ultrasound positive patients, 75 (66.37%) (True Positive) had intussusception and 01 (0.88%) (False Positive) had no intussusception on operation. Among, 37 ultrasound negative patients, 04 (3.54%) (False Negative) had intussusception on operation whereas 33 (29.20%) (True Negative) had no intussusception ($p<0.0001$) as shown in Table-3.The age and gender distribution of confirmed intussusceptions is presented in Table-4.

The overall sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of ultrasonography in the diagnosis of intussusception in children were calculated to be

94.94%, 97.06%, 98.68%, 89.19% and 95.57% respectively as shown in Table-5.

DISCUSSION

Intussusception is one of the most common acute abdominal emergencies among infants and small children and the second most common cause of intestinal obstruction after pyloric stenosis.[1] One large Swiss study found an overall incidence of 38, 31 and 26 cases per 100,000 live births in the first, second and third year of life respectively.[23] The subject has not been well studied in Pakistan.[19,24,25,26] This was not included in the objectives of our study.

The frequently reported male: female ratio is 3:1.[12,27] Muhammad JK et al[24] have reported a male to female ratio of 3.4:1 out of 71 patients. Mansur SH et al[25] have observed a male to female ratio of 2:1 in total of 38 cases. Munir A et al[26] have reported a male to female ratio of 1.6:1 out of 50 patients. In our study it was 2.2:1.

In children the cause of intussusception is said to be idiopathic in 90% of the cases.[8,27] In the remaining 10%, it is secondary to a pathological lead point such as Meckel's diverticulum, polyp, enteric duplication cyst and small bowel lymphoma, etc.[7,8] Such lead points are more commonly seen in children older than 3 years.[21] Ileocolic intussusception is considered to be the commonest type. Colo-colic and ileo-ileal intussusception are the other types.[7]

The clinical triad of intussusception consists of (a) acute colicky abdominal pain, (b) ''currant jelly'' or frankly bloody stools, and (c) either a palpable abdominal mass or vomiting, however, it is present only in approximately 50 % of patients and 20 % of patients are symptoms-free at clinical presentation or may present with non-specific symptoms and the diagnosis initially may be missed.[5,6,7,8,9] Gandapur ASG et al[19] in their study of 130 patients have observed the colicky abdominal pain and distension (88% each) followed by vomiting (82%) and bleeding per rectum (54%) as common presenting complaints. Pari et al[21] have reported colicky abdominal pain (44.3%), vomiting (15.6%), abdominal mass (18.2%) and Currant jelly stool in (8.3%) patients. Muhammad JK et al[24] have reported colicky abdominal pain (98.59%) as the commonest complaint followed by vomiting and abdominal distension (94.36% each), bleeding per rectum (85.91%) and palpable mass per abdomen (78.87%). In our study the common presenting symptoms were bilious vomiting (51.33%), screaming / abdominal pain (46.02%), stool mixed with mucous and blood (34.51%) and palpable abdominal mass (32.74%).

In 1977, Burke and Clark reported the sonographic features of intussusception for the first time in literature.[16] Ultrasonography is currently a well-established method for the evaluation of the small and large bowel.[2,18,27] The routine use of USG for the small and large bowel in children has significant geographic variations, particularly when looking beyond the evaluation of the appendix. It appears to be more commonly integrated as part of the pediatric bowel imaging work-up in Europe and Canada than in the USA.[3]

In the world literature, accuracy of ultrasonography in the diagnosis of intussusception has been reported with an overall sensitivity of 85% to 100% and a specificity of 88% to 100% and in children was94.94%, 97.06% and 95.57% respectively. [5,6,7,8,9,16,22] Intussusception is actually found in 30%–68% of children with suspicious clinical findings.[11] Naseem et al[20] have reported sensitivity of 100% and specificity of 95.2% in their study of 45 patients. In our study ultrasound supported the diagnosis of intussusception in 76 and operative findings confirmed intussusception in 79 out of total 113 patients. We found sensitivity of 94.94%, specificity of 97.06%, PPV of 98.68%, NPV of 89.19% and diagnostic accuracy of 95.57%. This substantiates the literature data and consolidate the primary role of ultrasound not only in diagnosis but in management of a pediatric patient with a strong clinical suspicion of intussusception.

CONCLUSION

Despite the fact that the advantages of ultrasonography have been documented for the evaluation of patients with clinical diagnosis or suspicion of intussusception, its use has been somewhat slowly accepted throughout the world. One of the reasons for this slow development may be that the radiologist's interest, training and experience are very important factors in performing and interpreting the gastrointestinal ultrasonography. We conclude that being non-invasive, free from hazards of ionizing radiation and due to its high sensitivity and specificity, ultrasonography is a safe, valuable and accurate tool of investigation in the diagnosis of intussusception in children. The study makes us confident that ultrasonography protocols for the screening and diagnosis of intussusception in clinically suspected children examined in radiology departments of our two tertiary -hospitals are reliable and consistent with the reports in world literature.

Conflict of Interest: The study has no conflict of interest to declare by any author.

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