



ORIGINAL RESEARCH PAPER

Radiodiagnosis

ROLE OF HIGH RESOLUTION SONOGRAPHY IN THE EVALUATION OF ACUTE ABDOMEN IN PEDIATRIC AGE GROUP

KEY WORDS:

Dr. J.S. Sikarwar

Professor and Head, Department of Radiodiagnosis, G.R. Medical College & Asso. Hospitals, Gwalior (M.P.), India

Dr. Harendra Singh Bharti*

P.G. Resident, Department of Radiodiagnosis, G.R. Medical College & Asso. Hospitals, Gwalior (M.P.), India *Corresponding Author

ABSTRACT

Acute abdomen is a medical emergency, in which there is sudden and severe pain in abdomen of recent onset with accompanying signs and symptoms that focus on an abdominal involvement. It can represent a wide spectrum of conditions, ranging from a benign and self-limiting disease to a surgical emergency. Ultrasound is one of the important method of investigating the child with acute abdominal pain and may provide a definitive diagnosis for many of the more common childhood pathologies. The development of higher frequency transducers and Doppler have resulted in the widespread use of sonography for diagnosing childhood disease. USG is very useful in children because it is non-invasive, cost-effective, repetitive and doesn't expose the child to radiation. The purpose of this study was to evaluate the role of sonography in the diagnostic work-up of children with acute abdomen in the emergency set-up.

METHODOLOGY- This is a prospective study was conducted on 100 children for a period of 1 year in Gajra Raja Medical College & associated hospitals who attended pediatric OPD or indoor department with acute abdominal pain were scanned and included in our study.

RESULTS- Among 100 patients presented with acute abdomen 91% cases (n=91) had their diagnosis made by USG and clinical examination on initial scan, on subsequent scan 96% cases (n=96) has been reached their diagnosis.

CONCLUSION- HRUSG is better investigative modality in the diagnostic evaluation of acute abdomen in children.

INTRODUCTION -

Acute abdomen can be defined as "A syndrome induced by wide variety of pathological conditions that require emergent medical or more often surgical management". Ultrasonography since its first use for diagnosing acute abdomen pre-operatively, has been used in various acute abdominal conditions. An early and accurate diagnosis is essential for prompt and appropriate management in order to limit morbidity and mortality. Moreover identification of surgical problems is utmost importance, as most patients of acute abdomen do not require surgery. A thorough history followed by meticulous clinical examination are no doubt cornerstone of efficient patient management. The lack of ionizing radiation involved in the use of ultrasound is particularly important in pediatric age group and can facilitate the triage process of further imaging or appropriate on ward referral. Knowledge of normal anatomical variant and the pathologies to children is essential.

MATERIAL AND METHODS

This is a prospective study was conducted for a period of 1 year from march 2019 to march 2020 in Gajra Raja Medical College & associated hospitals who attended pediatric OPD or indoor department with acute abdominal pain were scanned in the department of Radiodiagnosis, Gajra Raja Medical College.

Sample size: 100 children

Inclusion criteria-

1. The age of patient is between 1-12 years
2. Patient present with acute abdominal pain within hours which is never experience before

Exclusion criteria-

1. Age <1year, >12 year
2. Trauma
3. Congenital abnormalities
4. Recurrent abdominal pain

Equipment: These studies conducted with real time equipment as follows:

1. Ultrasound machine with transducer frequency 3-5 MHZ.
2. High resolution sonography (frequency 6-9 MHZ)
3. Colour doppler sonography

High resolution ultrasound done in each and every patient who came to us with pain abdomen. Doppler sonography was done in selected patients to look for pattern of vascularity. All study performed in the Department of Radiodiagnosis, Gajra Raja Medical College, Gwalior (M.P.) with following high resolution ultrasound machines:

1. Aloka α6 (colour doppler & gray scale)
2. E-saote my lab seven (colour doppler & gray scale)
3. Mindray DC 30 (colour doppler & gray scale)

Method: All patients were scanned after taking a brief history and physical examinations, Some relevant basic investigation were also required for selected cases as:

- HB, TLC, DLC, ESR
- Urine examination – Routine/Microscopic
- Stool examination
- Plain x-ray chest and abdomen.

RESULTS

Table 1 : Causes of acute pain abdomen in children

Causes	No. of cases(n)	Percentage (%)
Mesenteric adenitis	23	25
KUB stone	15	17
Intestinal obstruction	15	16
Acute appendicitis	12	13
Peritonitis	10	11
Abscess	9	10
Miscellaneous	7	8
Total	91	100

91 % cases(n=91) had their diagnosis made by USG on initial scan. NO specific diagnosis could be reached in 9% cases(n=9). Follow up of these patients revealed cystitis in 3 patient, gastric outlet obstruction in 1 patient and pancreatitis in 1 patient. A total 96% cases(n=96) had their diagnosis made by high resolution ultrasonography. 4% cases(n=4) not diagnosed by USG which on MDCT diagnosed as Omental infarct (1 case), Mesenteric ischemia (1 case), Epiploic appendagitis (1 case) and Crohn's disease (1 case).

Table 2-Age wise distribution of diseases

Disease	1-5 yrs(n)	5-8 yrs(n)	8-12 yrs(n)	Total
Mesenteric lymphadenitis	4	7	12	23
KUB stones	1	4	10	15
Intestinal obstruction	2	5	8	15
Acute appendicitis	-	4	8	12
Peritonitis	1	3	6	10
Abscess	1	2	6	9
Cystitis	-	1	2	3
Pancreatitis	-	-	1	1
Gastric outlet obstruction	-	-	1	1
Miscellaneous	1	2	4	7
Total	10	28	58	96

Table 3-Sex wise distribution of diseases

Disease	Male (n)	Female (n)	Total
Mesenteric lymphadenitis	10	13	23
KUB stones	10	5	15
Intestinal obstruction	8	7	15
Acute appendicitis	7	5	12
Peritonitis	6	4	10
Abscess	6	3	9
Cystitis	1	2	3
Gastric outlet obstruction	-	-	1
Pancreatitis	1	-	1
Miscellaneous	3	4	7
Total	52	44	96

Table 4 - Mesenteric lymphadenitis Location

Location	No. of cases(n)	Percentage(%)
Paraumbilical	13	56.5
Paraumbilical & LUQ	5	21.7
Right lower quadrant	2	8.6
Para aortic	3	13
Total	23	100

Table 5(a) : Mesenteric lymphadenitis –Size(short axis)

Size of nodes(in short axis)	No. of cases(n)	Percentage (%)
≥5 mm & <10 mm	19	82.6
≥10 mm	4	17.3
Total	23	100

Table5(b):- Mesenteric lymphadenitis –Size(long axis)

Size of nodes(in short axis)	No. of cases(n)	Percentage(%)
≥10 mm & <15 mm	15	65.2
≥15 mm	8	34.7
Total	23	100

We are taking abnormal nodes as patients having-

1. Mesenteric groups of lymph node having short axis diameter ≥ 5 mm and long axis diameter >10mm.
2. Conglomerate or rounded (L/T Ratio ≤ 1)nodes with central necrosis.
3. Clusters of lymph nodes (presence of 3 or more closely positioned L.N.)

Table 7 : Mesenteric lymphadenitis Types

Type	No. of cases(n)	Percentage(%)
Discrete	17	73.9
Conglomerate	5	21.7
Central necrosis	1	4.3

Total	23	100
--------------	-----------	------------

Table 8 : Mesenteric lymphadenitis -Additional finding

Additional finding with mesenteric lymph nodes	No. of cases(n)	Percentage (%)
Ascites (clear)	3	13
Ascites with septae	1	4.3
Mesenteric thickening	1	4.3
No additional finding	18	78.2
Total	23	100

Table 8- KUB stones

KUB stones	No. of cases(n)	Percentage (%)
Kidney	4	26.6
Ureteric stone with hydronephrosis	8	53.3
Bladder	3	20
Total	15	100

Table 9 : KUB stones -Type and no. of stones

Stones	No. of cases(n)	Percentage (%)
Single	5	33.3
Multiple	8	53.3
Staghorn	2	13.3
Total	15	100

Table 10- Intestinal obstruction

Causes	No. of cases (n)	Percentage (%)
Intussusception	5	33.3
Inguinoscrotal hernia	3	20
Adhesive bands	2	13.3
Paralytic ileus	2	13.3
GI tuberculosis	2	13.3
Worm impaction	1	6.6
Total	15	100

Table 11(a)- Appendicitis

Causes	No. of cases(n)	Percentage (%)
Lymphoid hyperplasia	5	41.6
Appendicolith	3	25
Mucus impaction	1	8.3
Other inflammatory diseases	3	25
Total	12	100

Table 11(b)- Appendicitis location

Position	No. of cases(n)	Percentage (%)
Retrocecal	7	58.3
Subceacl	2	16.6
Others	3	25
Total	12	100

Table 12 : Peritonitis

Peritonitis	No. of cases(n)	Percentage (%)
Perforation	3	30
Postoperative	4	40
Inflammatory diseases	2	20
No identifiable cause	1	10
Total	10	100

Table 13 : Abscesses

location	No. of cases(n)	Percentage (%)
Liver	6	66.6
Pelvic region	2	22.2
Renal	1	11.1
Total	9	100

Table 14 :Miscellaneous causes

Cases	No. of cases(n)	Percentage(%)
Ovarian Cysts	2	28.5
Pancreatitis	2	28.5
Cholelithiasis	2	28.5
Testicular torsion	1	14.2
Total	7	100

DISCUSSION-

Mesenteric adenitis is considered one of the most common non surgical cause of acute abdominal pain. In our study , we took the size of enlarged mesenteric lymph nodes is $\geq 5\text{mm}$ in short axis and $\geq 10\text{mm}$ in long axis . In this study 25% cases are diagnosed to have mesenteric adenitis. A lot of study has been done on lymph nodes shortest and longest diameter with the presence of absence of abdominal pain. S. Sabal et al² recorded EMLNs($>8\text{mm}$ in short axis) in 17.07% cases. V.S. Balakrishnan et al³ recorded EMLNs($\geq 5\text{mm}$ in short axis and $\geq 10\text{mm}$ in long axis) in 56.4% cases and 11.6% controls (p<0.001).

A high incidence of KUB stones is noted in the study. 17.0% of the diagnosed patients were suffering from stones. Gwalior-Chambal region may be responsible for higher and early age incidence of stones. The classic presentation of KUB calculus is acute flank pain. We diagnosed 53.3% cases of ureteric calculi among all KUB stones , all cases were associated with hydronephrosis of various grades. More recently, non-contrast thin section MDCT has been introduced as a means to assess for urinary tract calculi with sensitivity $>95\%$ and specificity $>96\%$ over conventional radiography and USG⁴.

Intestinal obstruction is one of the commonest surgical emergency encountered in the pediatric age group which has to be managed quickly. There are various sonographic findings present in the various causes of intestinal obstruction with dilatation of bowel loops proximal to the obstruction ; small bowel loops $\geq 3\text{ cm}$ and large bowel loops $\geq 5\text{ cm}$ (cecum $\geq 6\text{ cm}$)^{5,6}. In our study the most of cases (33.3%) are due to intussusceptions . Sarah E. Frasure et al in march 2018 recorded sensitivity of 93.8% and a specificity of 93.3% when compared to abdominal CT.

Acute appendicitis came out to be most common surgical cause of pain abdomen in children. An appendicitis that is greater than 6 mm in diameter and sausage-shaped, blind-ended , tubular , non compressible & non peristaltic noncompressible suggests acute appendicitis⁷. Doppler imaging may aid in the diagnosis, because the acutely inflamed appendix shows increased flow compared with normal bowel. In a study by Daga.S.⁸ the observed sensitivity, specificity, positive predictive value, and negative predictive value of ultrasonography (US) in the diagnosis of acute appendicitis were 96.5%, 85.7%, 98.8%, and 66.7%, respectively, with an overall accuracy of 95.7% and 75% patients of appendicitis showed hyperemic color Doppler flow. Furthermore, the use of color and power Doppler sonography was more helpful in those patients where it was difficult technically to visualize the entire appendix. We got 13 % cases(n=12) of appendicitis in which lymphoid hyperplasia causing appendicitis in 5 cases (41.6%) & appendicolith in 3 cases (25%).

Peritonitis is defined as inflammation of the peritoneum, which may be caused by pathogens or non-pathogenic factors. Peritonitis can be classified into primary, secondary or tertiary peritonitis⁹. A study by S.C.Chen et al¹⁰ USG can accurately diagnosed peritonitis in 83.3% cases. In our study we find 11% cases(n=10) of peritonitis out of which 30% cases(n=3) is due to perforation and 40 % (n=4) is due to postoperative complications.

Abscesses are focal confined collections of suppurative inflammatory material.¹¹ In our study 4 out of 6 cases(75%) of liver abscesses came out to be amoebic on culture , the

majority of patients presented with right hypochondrial pain with or without fever and tender hepatomegaly. The accuracy of Ultrasound for the diagnosis of abscesses varying between 61% and 96%.^{12,13,14}

There are several miscellaneous causes of acute abdomen. We have find total 7 such causes. Anechoic cyst $>3\text{ cm}$ in either ovaries are considered ovarian cysts¹⁵. in our study we find 28.5 % cases(n=2) of ovarian cyst.

Testicular torsion occurs when a testicle torts or twist on the spermatic cord resulting in the cutting off of blood supply that causes acute testicular and lower abdominal pain¹⁶. Time interval is particularly very important in the management of testicular torsion because expedient diagnosis and surgical management are critical if the testis is to be salvaged and testicular infarction prevented. We got 14.2 % cases(n=1) of testicular torsion in our study.

Cholelithiasis not as rare in children as it seems to be, as we got 28.5% (n=2) cases of cholelithiasis in our study. We got 2 cases of pancreatitis (28.5% of all miscellaneous causes), out of which 1 case is due to pancreatic divisum (MDCT done by the clinician to rule the cause) . Urinary tract infection particularly cystitis is very common in children mostly in females due to ascending infection in most of the cases. We got 3 cases of cystitis in 96 totally diagnosed cases. We got 1 case of Gastric outlet obstruction. It is a syndrome that resulting from mechanical obstruction of stomach emptying. We can't find the exact cause of gastric outlet obstruction. Most common cause of this condition is benign gastric or duodenal ulcers¹⁷. Studies are available that have compare the role of USG and abdominal X-RAY in acute abdomen^{18,19}. Walsh et al while evaluating the role of immediate USG in acute abdomen showed that USG was more informative than plain X-Ray in 40% of their cases. Simeone et al shown that while plain films scored over USG in 5% cases only. **CONCLUSION**

-:

- Sonography is the first choice of investigation in pediatric patients with acute abdominal pain, as it is easily available, has a high yield, cheaper, radiation free, can be repeated time to time to see the effect of treatment, though the accuracy depends on skill and experience of examiner.
- In Gwalior-Anchal region where the study was carried out, higher numbers of patients were having organic causes of abdominal pain.
- Mesenteric lymphadenopathy is most common and often the only abnormal, finding on ultrasound in children with acute abdominal pain.
- There is limited role of ultrasound in making final diagnosis gastrointestinal diseases, so further evaluation is needed.

REFERENCES

1. Das S: Examination of an acute abdomen. A manual of clinical surgery Ch 2000;33:335-356.
2. Sabal S, Poswal L, Gediya S, Goyal S. Mesenteric lymphadenopathy in children with recurrent abdominal pain. Int J Contemp Pediatr 2017;4:1525-8
3. Balakrishnan, V.S., Aroor, S., Kumar, S., Kini, P.G. and Saseendran, A., 2018. Mesenteric lymphadenopathy in children with chronic abdominal pain. Sri Lanka Journal of Child Health, 47(4), pp.348-353. DOI: <http://doi.org/10.4038/sljch.v47i4.8598>
4. Smith RC, Verga M, McCarthy S, Rosenfield AT. Diagnosis of acute flank pain: Value of unenhanced helical CT. AJR Am J Roentgenol. 1996;166:97-101.
5. Silva AC, Pimenta M, Guimarães LS. Small bowel obstruction: What to look for. Radiographics. 2009;29:423-39.
6. Ogata M, Mateer JR, Condon RE. Prospective evaluation of abdominal sonography for the diagnosis of bowel obstruction. Ann Surg. 1996;223:237-41.
7. Puylaert JB. Acute appendicitis: US evaluation using graded compression. Radiology. 1986;188 (2):355-60.
8. Daga S, Kachewar S, Lakhkar DL, Jethlia K, Itai A. Sonographic evaluation of acute appendicitis and its complications. West Afr J Radiol 2017;24:152-6
9. <http://rene-holzheimer.de/> Medical Faculty, Martin Luther University Halle-Wittenberg, Halle, Germany.
10. Chen S, Lin F, Hsieh Y, Chen W. Accuracy of Ultrasonography in the Diagnosis of Peritonitis Compared With the Clinical Impression of the Surgeon. ArchSurg.2000;135(2):170-174. doi:10.1001/archsurg.135.2.170
11. Kumar V, Abbas AK, Fausto N et-al. Robbins and Cotran pathologic basis of

- disease.W B Saunders Co.(2005) ISBN:0721601871.
12. Wang HF, Wang CE, Chang CF, Kao JY, Yu L, Chiang YN: The application and value of ultrasonic diagnosis of liver abscess; a report of 218 cases. *Chin Med J* 83: 133-140.
 13. Richardson R, Norton LW, Eule J, Eiseman B: Accuracy of ultrasound in diagnosing abdominal masses. *Arch Surg* 110:933-936, Aug 1975.
 14. Maklad NF, Doust BD, Baum JK: Ultrasonic diagnosis of post-operative intra-abdominal abscess. *Radiology* 113:417-422, Nov 1974.
 15. Levine D, Patel MD, Suh-Burgmann EJ, Andreotti RF, Benacerraf BR, Benson CB et al. Simple Adnexal Cysts: SRU Consensus Conference Update on Follow-up and Reporting. (2019) *Radiology*. 293 (2):359-371
 16. Bhatt S, Dogra VS. Role of US in testicular and scrotal trauma. *Radiographics*. 2008;28 (6):1617-29. doi:10.1148/rg.286085507
 17. Eisenberg RL. *Gastrointestinal radiology*. Lippincott Williams & Wilkins. (2003) ISBN:0781737060.
 18. Simeone JF et al: Comparison of plain film and sonography in valuation of acute abdomen. *AJR* 1985; 144:49- 52.
 19. Walsh PF, Crawford D, Crossling F T, Sutherland GR, Negrette JJ, Shand J: The value of immediate ultrasound in acute abdominal conditions. A critical appraisal. *Clin. Radiol* 1990; 42:47-49..