

Role of Gray Scale Ultrasonography and Doppler Ultrasonography for the Diagnosis of Surgical Causes of Acute Abdomen in Infants

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Abstract

Objective: To identify the role of Gray scale Ultrasonography and Doppler ultrasonography for the diagnosis of surgical causes of acute abdomen in infants.

Material & Methods: This retrospective cross-sectional study was performed at the diagnostic department of Combined Military Hospital Lahore from October 2022 to July 2023. All infants, who met the requirements for inclusion or exclusion were enrolled. Complete patient's history related to their demographic data, presence of pain and associated symptoms was taken. Data entry and analysis was done by using SPSS version-26.

Results: The reports were collected from 100 patients out of which 58 were males and 42 were females. All patients of acute abdomen underwent detailed ultrasound examination. Out of 100 patients 28% of infants were diagnosed with Appendicitis, 15% of infants with Meckel's Diverticulum, 14% with Intussusception, 13% with Volvulus, 23% with Inguinal hernia and in 7% of infants no significant abnormality was seen.

Conclusion: Gray scale is very effective diagnostic tool and color doppler ultrasonography aids in the confirmation for Diagnosing the Surgical causes of Acute abdomen in infants.

Keywords: Abdomen, Acute, Appendicitis, Intussusception, Intestinal Volvulus, Meckel Diverticulum, Hernia, Inguinal

How to cite: Batool F, Ajmad F, Naz M, Ramzan F, Aslam K, Tariq A. Role of Gray Scale Ultrasonography and Doppler Ultrasonography for the Diagnosis of Surgical Causes of Acute Abdomen in Infants. *Esculapio - JSIMS* 2024;20(04): 591-594

DOI: <https://doi.org/10.51273/esc24.251320427>

Introduction

An acute abdomen is a problem that has to be treated right away. Acute abdominal pain might be brought on by an infection, inflammation, blockage or occlusion of a blood vessel.¹ Usually, the patient appears with an abrupt onset of vomiting and nausea along with stomach discomfort.

There are both surgical and non-surgical causes of acute abdomen, the patient needs a surgical treatment due to Appendicitis, Intussusception, Meckel's Diverticulum, Volvulus and Hernia.^{2,3} It can also be caused by something benign, but it interferes with daily activities. Nume-

rous diseases that might cause acute and chronic abdominal discomfort must be ruled out as part of the evaluation process.^{4,5}

Symptoms and signs that suggest surgery include fever, bilious vomiting, bloody diarrhea, voluntary guarding, stiffness, and rebound tenderness. The differential diagnosis might be narrowed down depending on the child's age.⁶ A diagnostic conundrum arises when infants experience acute stomach pain.⁷ Even though most cases of acute stomach pain are harmless some need to be diagnosed and treated right once to reduce morbidity.^{8,9} Appendicitis is the most typical surgical cause, while gastroenteritis is the most typical medical cause. The history and physical examination are typically enough to identify the stomach pain.¹⁰ Age has a significant role in determining the cause because the incidence and symptoms of certain illnesses change significantly as children get older.¹¹ Contrary to medical situations, pain typically comes before vomiting in the acute surgical abdomen. In many cases, food poisoning or gastro-

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Submission Date:	16-08-2024
1st Revision Date:	06-09-2024
Acceptance Date:	11-12-2024

enteritis are linked to diarrhea.¹² Intussusception and acute appendicitis are two acute pediatric abdominal diseases that can be evaluated very well using ultrasound.⁽¹³⁾ The purpose of the study is to describe the Role of ultrasonography to diagnose the Acute Abdomen among infants that is helpful for making surgical decisions. It eliminates the risk of radiation exposure that is caused by CT scan. Anesthesia is often required for Computed Tomography (CT) or Magnetic Resonance Imaging (MRI) scans of infants with stomach pain, as they cannot remain still. However, Ultrasound (US) can obtain diagnostic images without anesthesia, being far less expensive than CT or MR imaging.

Material and Methods

This Retrospective Descriptive cross sectional study was done from October 2022 to July 2023 on 100 pediatric patients under one Year of age presented with acute abdominal pain at the diagnostic department of Combined Military Hospital Lahore from October 2022 to July 2023 after the approval of ethical review committee having case no.650/ERC/CMH/LMC. All the detailed history was collected including the age, duration of pain and other associated symptoms. Convenient type of Non probability sampling technique was employed. Post traumatic patients were excluded. Examination was done with Toshiba Xario ultrasound machine with high frequency of 7-12MHz linear array transducer. All data was written and evaluated from SPSS 26.0. Mean and standard deviation were computed for quantitative variables in the descriptive analysis, whereas frequencies and percentages were computed for qualitative data. Data was analyzed at 95% of confidence-interval. P-value ≤ 0.05 was taken as significant.

Results

The data was collected from total of 100 pediatric patients under the age of one year. Table:2 shows the descriptive analysis of patient's symptoms. Out of total 100 infants

40 were presented with severe pain. While 37 infants had symptoms of vomiting. Table 3 shows the Descriptive analysis of gray scale US and doppler US findings

Table 2: Descriptive analysis of patient's symptoms

Variables	Responses	N(%)
Pain severity	Mild	60(60)
	Severe	40(40)
Vomiting	Yes	(37)37
	No	43(43)
	Sometimes	20(20)
Total		100(100)

Table 3: Frequency of sonographic findings of acute abdomen

Variables	Responses	N(%)
Appendix probe tenderness	Positive	29(29)
	Negative	71(71)
Appendix wall thickness	Increased	26(26)
	Normal	74(74)
Appendiceal wall hyperemia	Yes	27(27)
	No	73(73)
Appendix lumen diameter	Increased	27(27)
	Normal	73(73)
Meckel's diverticulum lumen diameter	Increased	16(16)
	Normal	84(84)
Meckel's diverticulum wall margins	Regular	76(76)
	Irregular	24(24)
Meckel's diverticulum on doppler USG	Positive	17(17)
	Negative	83(83)
Intussusception obstruction	Present	12(12)
	Absent	88(88)
Intussusception sign appearance	Present	16(16)
	Absent	84(84)
Intussusception vascularity	Increased	16(16)
	Normal	84(84)
Volvulus obstruction	Yes	13(13)
	No	87(87)
Volvulus whirlpool sign	Present	12(12)
	Absent	88(88)
Volvulus free fluid	Present	12(12)
	Absent	88(88)
Volvulus vascularity	Increased	13(13)
	Normal	87(87)
Hernia bulging sign	Present	28(28)
	Absent	72(72)
Hernia abdominal contents	Present	32(32)
	Absent	68(68)
Hernia vascularity	Increased	27(27)
	Normal	73(73)
Total		100(100)

Table 1: Demographics of patients

Variables	Responses	N(%)
Age of patients (Months)	1 – 3 Months	27 (27)
	4 – 6 Months	17(17)
	7 – 9 Months	27(27)
	10 -12 Months	29(29)
Gender	Female	42(42)
	Male	58(58)
Total		100(100)

of Acute Abdomen. Figure 1 shows surgical causes of acute abdomen diagnosed on gray scale and Doppler ultrasound.

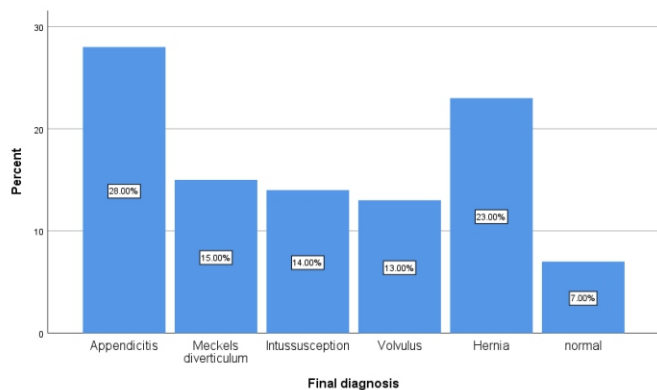


Figure 1: Surgical causes of acute abdomen diagnosed on ultrasound

Discussion

Yoshino T. Sameshima et al. conducted a study back in November 2017 on the difficult sonographic inguinal canal evaluation in neonates and children: an update of differential diagnoses, they came to the conclusion that inguinal bulging is a prevalent issue in children, and sonographic data can be difficult for radiologists to interpret.¹⁴ In our study the US positive results included 28% hernia with bulging sign, 32% hernia with abdominal contents and 27% increased hernial vascularity. While Yoshino et al. highlighted the challenges in sonographic inguinal canal evaluation, particularly in differentiating between hernia and normal variations, our study provides specific sonographic findings associated with inguinal hernia in infants and children. These findings, including the presence of a bulging sign, abdominal contents within the hernia sac, and increased vascularity, can aid in accurate diagnosis and management. In May 2022, Blades CA, Knowles GA and Francis W reported pediatric patient's with potentially unusual example of acute mesenteroaxial gastric volvulus. In their study the fifth decade of life was the highest incidence of gastric volvulus, an uncommon cause of non-bilious vomiting that involves the rotation of stomach around its axis. Acute stomach volvulus poses a serious risk to life, necessitating an immediate diagnosis and treatment to minimize serious morbidity and fatality.¹⁵ In our study 13% of infants were diagnosed with volvulus and also presented with pain and vomiting, In which male infants were more than females. Mostly, volvulus

obstruction was reported in 13% of infants, volvulus whirlpool sign reported in 12% of infants and increased volvulus vascularity was seen in 13% of infants. While Blades et al. reported a case of acute mesenteroaxial gastric volvulus in a pediatric patient, our study provides a broader overview of sonographic findings associated with gastric volvulus in infants.

In China a study was conducted on appendicitis in infancy by Y.Lin and C.lee in which they find out the most frequent cause of stomach pain in children requiring surgery is acute appendicitis. Seven infants (ranging in age from 17 days to 8 months) were treated with acute appendicitis. Three were gangrenous, three were gangrenous with perforation, and one was suppurative and one patient expired.¹⁶ While in our study 18% of infants were diagnosed with appendicitis along with the signs and symptoms of pain and vomiting and the appendicitis was seen with the features of positive probe tenderness in 29% of infants, appendiceal wall hyperemia in 27% of infants and also with increased appendicular lumen diameter in 27% of infants. Mostly were male infants as compared to females. While Lin and Lee's study highlighted the significant role of acute appendicitis as a cause of surgical abdominal pain in infants, our study provides additional insights into the sonographic features of appendicitis in this age group. Our findings demonstrate that sonography can effectively identify appendiceal inflammation, including wall hyperemia, increased luminal diameter, and positive probe tenderness.

Conclusion

In infants with acute abdomen, gray scale ultrasound serve as a highly effective 1st line diagnostic tool for identifying surgical causes. Color Doppler ultrasonography further enhances diagnostic accuracy by confirming blood flow patterns and aiding in the differentiation of benign and pathological conditions.

Conflict of Interest: None

Funding Source: None

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Authors Contribution

FB: Conceptualization of Project

MN: Data Collection

KA: Literature Search

FR: Statistical Analysis

AT, FB: Drafting, Revision

FA: Writing of Manuscript