An Appraisal of the Role of Ultrasonography in Pediatric Abdominal Pain in Jos, North-Central Nigeria

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Abstract. Abdominal pain is a common complaint in paediatric age group and a reason for frequent hospital visits warranting an abdominal sonogram. Ultrasonography is non-invasive, readily available, cheap, reproducible and a quick and reliable technique in evaluating children with abdominal pain to arrive at possible differential diagnosis. The aim of this study was to appraise the role of ultrasonography in evaluating abdominal pain in children and to document the incidence of various specific conditions causing abdominal pain in the children (< 18 years). *Materials and Methods.* A five (5) year retrospective review of the archive of children aged < 18 years with abdominal pain sent to the Department of Radiology of the Jos University Teaching Hospital for abdominal sonography between January 2015 and December 2020. *Findings.* The abdominal ultrasound was normal in 60.0% of the patients suggesting a non-specific aetiology of the abdominal pain. Other common abdominal ultrasound findings were mesenteric adenitis (32.4%), urinary tract infection (1.8%), hepatomegaly (1.7%) and acute appendicitis (1.2%). The least findings were imperforate hymen (0.1%), nephroblastoma (0.1%) and umbilical hernia (0.1%). *Conclusion.* Ultrasonography remains a very effective, complementary and non-invasive method for evaluating children with abdominal pain as it is instrumental in the diagnosis and guide patient care. Emergency medicine physicians should have a foundation in the basics of point-of-care ultrasound. Being proficient at using ultrasound will be an invaluable skill in expediting patient care by providing a quick diagnosis and disposition while avoiding ionizing radiation.

Keywords: Ultrasonography, Abdominal pain, Children, Mesenteric Adenitis

Introduction

Ultrasound (US) examination in the field of Medicine was introduced in the early 1950's and since then has rapidly developed to have a premier role in the diagnosis, intervention, follow-up and evaluation of disease management (Mwango *et al.*, 2012). The Colour Doppler ultrasound allows for the assessment of blood flow parameters, spectral waveform pattern and other relevant indices thus improving the diagnostic accuracy of ultrasound in the evaluation of the abdomen in children with abdominal pain.

Acute abdominal pain encompasses a spectrum of surgical, medical and gynecological conditions, ranging from trivial to life threatening. Pediatric abdominal pain is a common problem that often poses diagnostic dilemma.

A wide spectrum of aetiologies can cause abdominal pain, and diagnosis can be challenging. In most cases, a thorough history and physical exam can narrow the differential diagnoses (BMJ Best practice, 2021). However, in some instances additional laboratory investigations and radiological evaluation are required to confirm the diagnosis.

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Furthermore, even with the assistance of parents or guardians, a comprehensive history is often difficult to obtain, and diagnosis therefore relies heavily on the clinical acumen of the practitioner (BMJ Best practice, 2021) and his/her ability to utilize the various imaging tools at his/her disposal.

The vast majority of episodes are benign and self-limiting, but persistent abdominal pain may signify an underlying pathology requiring urgent intervention (D'Agostino, 2002). Although most children with abdominal pain have self limited condition such as constipation, gastroenteritis, or viral syndrome (D'Agostino, 2002). However, in some instances the pain may herald a surgical or medical emergency. The most difficult challenge for the clinician is to identify those few children who have uncommon and potentially life-threatening conditions that require urgent evaluation and treatment such as appendicitis, intussusception, volvulus, or adhesion (D'Agostino, 2002; Grant *et al.*, 2008).

The frequency of surgical intervention in children presenting with acute abdominal pain is about 1%, but the possibility of overlooking a serious organic aetiology is a major concern for physicians (Grant *et al*., 2008). Unfortunately, a small number of children with acute abdominal pain may not receive a definitive diagnosis on first evaluation because of the early stage of the disease or subtle and atypical signs (Kim, 2013). Accurate and timely diagnosis is the key to preventing significant morbidity and mortality. Abdominal ultrasound finds usefulness in the evaluation of patients with abdominal pain in emergency department. Ultrasonography is frequently the preferred imaging modality of choice in the paediatric population (The ALARA, 2002). It is noninvasive, cost-effective, easy to use, portable, and requires no sedation; however, the reliability of ultrasound is highly operator dependent.

The purpose of this study was to re-appraise the role of sonography in children with abdominal pain in the Jos and document the common and clinically significant causes of abdominal pain in this age group in our environment.

Materials and Methods

A five (5) year retrospective review of the archive of abdominal sonogram of children (age < 18 years) with abdominal pain sent to the department of Radiology of the Jos University Teaching Hospital for abdominal ultrasound between January, 2015 to December, 2020 was conducted. Patients with incomplete documentations were excluded from the study. A total of 1,985 results were reviewed but only 836 who met the inclusion criteria were enrolled for the study.

The abdominal ultrasound examinations was performed using Logiq-5 (General Electric, 2007 USA) ultrasound machine fitted with a 3.5 MHz curvilinear transducer in supine position and 10 MHz linear transducer was utilized where needed. Grayscale ultrasound was first conducted to determine the size and echogenicity of the abdominal viscera and guts. Colour Doppler interrogation was done to assess blood flow where applicable.

Demographic data obtained included age, sex, clinical indications and abdominal ultrasound final diagnosis. The data was collated, entered into a computer and processed by the use of Statistical Package for Social Sciences (SPSS) version 23 to determine frequencies; means ± standard deviations. Results are presented using frequency tables and percentages as appropriate. A p-value of <0.05 was considered statistically significant with a confidence interval of 95%.

The hospital's ethical committee and review board concurred that this retrospective study was a continuous quality improvement initiative for patient care and did not require informed consent.

Results

Patients' Demography

A total of 1985 abdominal ultrasound scan results were reviewed but only 836 with complete documentation and met the inclusion criteria were enrolled for the study, a prevalence of 42.1%. Of these patients, 468 (56.0%) were females, 368 (44.0%) were male giving a male to female ratio of 1:1.3 and their ages ranged from 2-17 years with a mean age of 10.71 ±4.43 years (Table 1).

Relationship between Sex and Age Group

Males in the age groups 5-9 years and 10-14years constituted 29.3% and 38.9% respectively compared with 26.3% and 35.7% females in the same age groups respectively. This was statistically significant (Table 1, $p<0.005$).

Table 1. Relationships between age groups and gender of patients

Sex	Age group (years)				Total (%)
	0-4	5-9	10-14	15≤18	
Male	54 (14.7)	108 (29.3)	143 (38.9)	63 (17.1)	368 (100.0)
Female	36 (7.7)	123 (26.3)	167 (35.7)	142 (30.3)	468 (100.0)
Total (%)	90 (10.8)	231 (27.6)	310 (37.1)	205 (24.5)	836 (100.0)
Mean	10.71 ± 4.43	Df = 3	$X^2 = 25.276$	P = 0.000	

Ultrasound Findings in Children with Abdominal Pains

The common abdominal ultrasound findings in children with abdominal pains were mesenteric adenitis (32.4%), urinary tract infection (1.8%), hepatomegaly (1.7%) and acute appendicitis (1.2%). The least findings were imperforate hymen, nephroblastoma and umbilical hernia constituting 0.1% each (Table 2).

Table 2. Ultrasound findings in children with abdominal pain

Ultrasound	Findings	Frequency (%)
Acute Appendicitis	10	1.2
Acute Hepatitis	2	0.2
Imperforate Hymen	1	0.1
Haemoperitoneum	2	0.2
Hepatomegaly	14	1.7
Splenomegaly	3	0.4
Umbilical Hernia	1	0.1
Incomplete Abortion	3	0.4
Ovarian Cyst	2	0.2
Pelvic Inflammatory Disease	7	0.8
Intestinal Obstruction	2	0.2
Nephroblastoma	1	0.1
Urinary Tract Infection	15	1.8
Mesenteric Adenitis	271	32.4
Normal (Non specific pain)	502	60.0
Total	836	(100.0)

Abdominal ultrasonographic finding was normal in 60.0% of the patients suggesting a non specific abdominal pain as a cause of the acute abdominal pain (Table 2).

The age groups 5-9 years and 10-14 years had the majority of the ultrasound findings of mesenteric adenitis constituting 42% and 38.7% respectively while age groups 0-4 years and 15-18 years had 10.0% and 8.5% respectively (Table 3).

Table 3. Age distribution of mesenteric adenitis in children with abdominal pains

Age Groups	Frequency	Percent (%)
0-4	27	(10.0)
5-9	116	(42.8)
10-14	105	(38.7)
15≤18	23	(8.5)
Total	271	(100.0)

Relationship between Ultrasound Diagnosis and Age Group

Abdominal ultrasonography detected abnormal abdominal findings in age groups 5-9 years and 10-14 years constituting 55.4% and 41.0% respectively while normal findings were observed in 44.6% and 59.0% for same age groups respectively. This is statistically significant (Table 4, $p<0.005$).

Table 4. Relationships between findings and age groups

Findings	Age group (years)				Total (%)	P-value
	0-4	5-9	10-14	15≤18		
Normal (Non specific pain)	57(63.3)	103(44.6)	183(59.0)	159(77.6)	502(60.0)	0.0001
Abnormal	33(36.7)	128(55.4)	127(41.0)	46(22.4)	334(40.0)	
Total	90(100.0)	231(100.0)	310(100.0)	205(100.0)	836(100.0)	

Note: Df-3 X^2= 49.758 P = 0.0001

Relationship between Ultrasound Diagnosis and Sex

Abdominal ultrasonography detected normal and abnormal abdominal findings in 54.6% and 45.4% males respectively while normal and abnormal findings were seen in 64.3% and 35.7% females respectively. This was statistically significant (Table 5, $p<0.05$).

Table 5. Relationships between findings and gender of patients

Findings	Sex		Total	P-value
	Male	Female		
Normal (Non specific pain)	201(54.6)	301(64.3)	502(60.0)	0.004
Abnormal	167(45.4)	167(35.7)	334(40.0)	
Total	368(100.0)	468(100.0)	836 (100.0)	

Note: X^2= 8.074 P = 0.004

Discussion

Pediatric abdominal pain is a common complaint evaluated in emergency departments (EDs). Although often due to benign causes, the varied and nonspecific presentations present a diagnostic challenge (Siegel, Carel & Surratt, 1991).

Eight hundred and thirty six (836) abdominal sonographic studies for abdominal pain in pediatric patients over a 5-year period were reviewed. Fifty six percent were female and 44% male, with an age range of 2-17 years (mean age, 10.71±4.43 years). These demographic figures are similar to those in the study done by Ramadan, Ali, and El barbary (2020) in Egypt which demonstrated 44.6% and 55.4% for male and female respectively with a mean

age of 9.28 ±2.92 years where 280 children between 1-16 years with abdominal pain were recruited. Abdominal pain seems to be more common in girls than boys but the reasons for the gender difference remain unclear. Thus, the potential gender-related difference points the complexity that surrounds this relationship and needs further investigation.

The demography is however at variance with the findings of Lin and Lin (2013) who documented a male predominance constituting 61.8% and 38.2% for males and females respectively with a mean age, 6 ±5.8 years (Lin & Lin, 2013).

In this study, normal ultrasound findings were recorded in 60.0% of the patients, suggesting a functional abdominal disorder was a cause of the abdominal pain. This term 'functional abdominal pain' refers to abdominal pain that has no anatomic, histologic, or "organic" etiology. This type of pain is the hallmark of functional gastrointestinal disorders (FGIDs) that include irritable bowel syndrome, functional dyspepsia, functional abdominal pain, and abdominal migraine. This finding is consistent with that reported by Siegel, Carel, and Surratt (1991) who found non-specific abdominal pain in majority of the children evaluated (30-38%). The other frequent diagnosis they reported were medical conditions (20-26%), and surgical emergencies (30-38%). Ramadan, Ali, and El barbary (2020) in Egypt also reported functional abdominal pain as the most common cause of abdominal pain (32.9%). This was followed by postoperative pain in 18.6%, then urolithiasis in 16.1%, parasitic infestation in 8.9%, mesenteric adenitis and hepatitis in 3.6% and 6.8% respectively. Ramadan, Ali, and El barbary (2020) stated that there was a statistical significant difference between cases as regard the sex, in favor of female than male in functional abdominal pain.

The most common positive abdominal ultrasound finding in this study in children with abdominal pain was mesenteric adenitis (32.4%). This was remotely followed by urinary tract infection (1.8%), hepatomegaly (1.7%) and acute appendicitis (1.2%). These observations are in agreement with Schulte *et al.* (1998) who reported mesenteric lymphadenitis (mesenteric adenitisileitis) as the most common diagnosis in children with abdominal pain (53%) in all 213 patients with acute abdominal pain. Sikorska-Wiśniewska *et al.* (2006) also found that in about 20% of the children studied, primary mesenteric lymphadenopathy was the cause of the acute abdominal pain.

It is however important to note that, enlarged abdominal lymph nodes are frequently encountered in asymptomatic children and should not always be considered abnormal as stated by Simanovsky and Hiller (2007). Enlarged abdominal lymph nodes exceeding 10 mm in their shortest axis in children with abdominal pain may represent mesenteric lymphadenitis of various causes (Sikorska-Wiśniewska *et al*., 2006).

With the routine use of high-frequency transducers, detection of enlarged abdominal lymph nodes greater than 5mm is very common in children with abdominal pain. When enlarged nodes are found with no other abnormality detected, the term "mesenteric lymphadenitis" is often used to describe an inflammatory process of abdominal lymph nodes.

The high proportion of children with mesenteric lymphadenitis as a cause of abdominal pain in our environment is not a strange finding. This is because high rates of childhood infections and infestations in our environment may be responsible for the mesenteric nodal enlargement as the body respond to the offending organisms.

The study by Lin and Lin (2013) however found the most common diagnosis in patients with acute abdominal pain to be acute appendicitis (19.1%) followed by acute calculus cholecystitis (15.4%), renal calculus disease (10.9%), acute pancreatitis (10%) and others (13.6%). It is important to note that Lin and Lin (2013) carried out their study in the general population with age of the patients ranging from 5 to 77 years (mean age – 41 years). This means diseases commonly found in adults such as appendicitis are more likely to be observed in higher frequency.

In our study, abdominal ultrasonography detected abnormal abdominal findings in the age groups 5-9 years and 10-14 years constituting 55.4% and 41.0% respectively while normal findings were observed in 44.6% and 59.0% for same age groups respectively. This is in agreement with findings by Oh *et al.* (2004) who reported that the incidence of recurrent abdominal pain in Singaporean children was around 23.4%, with a mean patient age of 11.7 years (range 6–17 years) and a female preponderance (62.4%). Plunkett and Beattie (2005) also reported that the chronic or recurrent abdominal pain (RAP) is a commonly encountered complaint in general practitioner and pediatrician clinics. Its prevalence ranges from 10%–45% in school-going children.

As mentioned by Sanchez *et al.* (2016), abdominal pain is very common in the pediatric population (<18 years of age). Sonography is a safe modality that can often differentiate the frequently encountered causes of abdominal pain in children (Plunkett & Beattie, 2005).

Limitations

The most important limitation of this study is that the sonographic results were obtained by a retrospective review of the records without inputs from further laboratory workup and clinical reviews.

Clinical information was insufficient in many cases except for those admitted to the wards. Furthermore, ultrasound is operator dependent and also depends on the performer's experience. Thus, this may affect the accuracy of diagnosis. Lastly, this study covered only the experience in one hospital. A prospective study in multiple centers for sonographic evaluation of abdominal pain in children is required.

Conclusion

Multiple etiologies are responsible for acute abdominal pain children. Ultrasonography is an effective, non-invasive and complementary imaging tool that may help narrow the differential diagnoses thus reducing morbidity and mortality in life threatening etiologies.

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Nil

Conflicts of Interest

There are no conflicts of interest.

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