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The Diagnostic Value of Abdominal Ultrasound in Children with Acute Abdominal Pain

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Abstract **Original Research Article**

***Background*:** Abdominal pain is a very common complains of patients attending medical emergency room. Pain abdomen accounts for about 5-10% of all emergency department visits. The abdominal pain in pediatrics can manifest as either acute or recurrent pain. It is defined as a severe, sudden, and persistent pain. ***Aim*:** This study aimed to analyze the use and limitations of abdominal sonography for acute abdominal pain in the pediatric age group and to assess the clinical indication for requesting an ultrasound for a patient with a history of abdominal pain. ***Method*:** This was a retrospective descriptive observational study conducted among all pediatric age group patient a presented with acute abdominal pain who done ultrasound in radiology department, Benghazi Children's Hospital attended in a period of one year. A total of 108 children were included in this study. Data were collected daily from radiological request. ***Results*:** A total of 108 children were presented through the radiology department during the period of study, with a slightly higher distribution of males (59, 54.6%) than females (49, 45.4%) among cases. The mean age was (7.71±3.66 years) ranged from 5 month to 14 years, with the median equal to 8 years. About one third of children (32, 29.6%) fall into the age group (9-11 years). The highest number of cases (49, 45%) came with pain at the Right side of abdomen, Fever was the most common symptom in the majority of cases (67, 62%), vomiting (22, 20.4%), diarrhea (20, 18.5%), abdominal distension (16,14.8%), urinary symptoms (10,9.3%), constipation (4, 3.7%), and weight loss (4,3.7%). The important diagnosis accounted (39.8%) including the following cases; acute appendicitis (26, 24.1%), perforated appendix (6,5.6%), intussusception (8,7.4%) urinary tract infection (2,1.9%), while the normal scan accounted (21,19.4%). ***Conclusion*:** As there is no requirement for patient anesthesia and no ionizing radiation, ultrasound is becoming an increasingly popular imaging technique for the examination of acute abdominal discomfort in pediatric patients. Ultrasound is generally the first modality used to detect GI tract problems in children. In this study, there were an overuse of US in non-specific conditions like mesenteric lymphadenitis.

Keywords: Analysis, Synthesis, Innovation, Connectivity, Sustainability.

1. INTRODUCTION

Abdominal pain is a very common complains of patients attending medical emergency room. Pain abdomen accounts for about 5-10% of all emergency department visits (White & Counselman, 2002). While for majority of patients, symptoms are self-limiting, few patients will develop "Acute abdomen", due to serious intra-abdominal disease requiring emergency intervention (Thakur & Kumar, 2019). Acute abdomen is defined as "a spectrum of surgical, medical and gynecological conditions ranging from trivial to life threatening conditions, which require hospital admission, investigations and treatment (Prasad *et al*., 2006). Acute abdomen can persist for several hours to days; clinical features are usually overlapping and many times misleading. The possible causes of acute abdomen may range from benign and psychogenic pain to life threatening aortic dissection (Thakur & Kumar, 2019). The abdominal pain in paediatrics can manifest as either acute or recurrent pain. Recurrent abdominal pain had been defined as an attack that occurred at least 3 times in 3 months within the past 1 year (Sukmana, 2020). Abdominal pain can be classified as somatoparietal, visceral or referred pain that can be a manifestation of a wide array of systemic and local causes (Mazzei *et al*., 2013). Acute gastroenteritis, acute appendicitis and abdominal trauma are common causes of pain abdomen in children and young adults. Intestinal obstruction, biliary diseases, diverticulitis and appendicitis are common culprits among middle aged and elderly patients. Common non-surgical causes include metabolic (DKA, severe dehydration and so on), and cardiac

emergencies (e.g. acute inferior wall myocardial infarction) (Leung & Sigalet, 2003). On the other hand, only one quarter of patients who have previously been classified with an acute abdomen actually receive surgical treatment, so the clinical dilemma is if the patients need surgical treatment or not and, furthermore, in which cases the surgical option needs to be urgently adopted (Cartwright & Knudson, 2008). Therefore, a thorough and logical approach to the diagnosis of abdominal pain is necessary. Some Authors assert that the location of pain is a useful starting point and will guide a further evaluation that the American College of Radiology has recommended using different imaging studies to assess abdominal pain based on pain location: ultrasonography (US) is recommended to assess the right upper quadrant pain, and computed tomography (CT) is recommended for the right and left lower quad rant pain (Rosen *et al*., 2011). However some causes are more frequent in the paediatric population (like appendicitis or adenomesenteritis) or are strictly related to the gender (i.e. gynaechologic causes). It is also important to consider special populations such as the elderly or oncologic patients, who may present with atypical symptoms of a disease. This concept also reflects a different diagnostic approach (kumar., 2019:Mazzeietal., 2013).

Imaging

Immediately after clinical evaluation, there is a considerable doubt about the urgency of the patient's condition (Rosen *et al*., 2015). Clinical evaluation alone is not sufficiently accurate for a specific diagnosis, and imaging modalities can increase the accuracy of diagnosis (Laméris *et al*., 2009). It should be noted, however, that imaging tests have false-positive and false-negative results, and in cases of high suspicion of a particular disease, it cannot be ruled out by referring to it alone (Abdolrazaghnejad *et al*., 2019). Radiation exposure is an important consideration before imaging in children. Radiation dose is dependent on the child's size. The cumulative effect of exposure over a lifetime of imaging needs to be assessed. Computed tomography (CT) of the abdomen and pelvis exposes a child to the equivalent of more than 100 chest radiographs. The risk of a radiation-induced solid cancer is estimated to be one per 300 to 390 CT scans of the abdomen and pelvis for girls, and one per 670 to 760 scans for boys (Miglioretti *et al*., 2013).

Imaging Methods

- **X-Ray Abdomen**

It is not routinely helpful, except in suspected surgical conditions. An erect X-ray of the abdomen might reveal air fluid levels in intestinal obstruction. A child with suspected perforation peritonitis may have pneumoperitoneum ('air under the diaphragm'). Impacted fecal matter may be seen in chronically constipated children (Iyer & Nallasamy, 2018).

- **Simple Radiography**

In the past, plain radiography, owing to its low cost and availability, was used as the primary imaging modality for patients with abdominal pain. Certainly, with the more accessible alternative methods, its use has become controversial. It is suggested that plain radiography should be used only in cases of intestinal obstruction, perforation, foreign body ingestion or catheter location (Panebianco *et al*., 2011). Using plain radiographs in patients with peritoneal symptoms, upright radiograph can detect air below the aperture. In cases where the sensitivity of plain radiographs is not sufficient for a given condition, such as a small bowel obstruction, the physician should consider that the plain radiography is normal in the event of a misdiagnosis (Abdolrazaghnejad *et al*., 2019). Computed tomography (CT) scan.

There are considerable sensitivity and specificity for several diseases causing abdominal pain. In cases where multiple diagnoses are commonly suspected, a very good diagnostic test is recommended. In stable patients whose pathology does not have a clear surgical procedure, but in differential diagnosis of the disease, they have important abdominal pathologies, CT scan is a good diagnostic test. We should consider the risk of future exposure to radiation in patients who are supposed to be CT. When using contrast, its cost/benefit should be measured (Abdolrazaghnejad *et al*., 2019) CT-angiography has high sensitivity and specificity in cases of mesenteric ischemia. The use of CT has increased in recent years, but its disadvantages include higher costs, latency in diagnosis with respect to waiting time for imaging, and risks such as contrast-induced allergy, contrast-induced nephropathy, and exposure to ionizing radiation (de Burlet *et al*., 2017).

- **CT Abdomen**

It is specific for most surgical conditions. However, in a sick child, clinical signs combined with X-ray and ultrasound are usually sufficient to arrive at a reasonable diagnosis and decide intervention. It is prudent to refer such children at the earliest to any emergency department where surgical expertise is available rather than spending time in obtaining imaging studies (Iyer & Nallasamy, 2018).

Magnetic Resonance Imaging (MRI) Imaging:

The use of a strong magnetic field, radio waves, and a computer, MRI scans can produce very detailed images of internal structures, such as the brain and spinal cord, muscles, tendons, ligaments, and blood vessels (Islam *et al*., 2023).

- **Ultrasound**

Ultrasound is the equipment used to diagnose the disease. An ultrasound scan could be a medical test that uses high-frequency sound waves to capture real time images of the organ. Different sorts of transducer or probe are used to supply the USG image. Abdominal

sonography could be a sort of USG study use high frequency transducer ranging from 3.5-10MHz). USG study used for the male and feminine patients to find out the pathologies. Ultrasound abdomen is one of the tests that's commonly employed in symptoms of abdominal pain. It is especially useful for soft tissue, solid organ, and fluid-filled anatomy (Marsland *et al*., 2018). Ultrasonography is relatively inexpensive and does not expose the patient to radiation. It is the first-line imaging choice for undifferentiated acute abdominal pain, unless history or physical examination identifies a specific diagnosis (Reust & Williams, 2016). Ultrasonography can be used to evaluate for bowel thickening in inflammatory bowel disease, focal intramural bowel hematomas in Henoch-Schönlein purpura, and bowel "target" sign in intussusception. It is also the primary imaging choice for pyloric stenosis, cholecystitis, pancreatitis, renal calculi, ovarian cysts, ovarian torsion, and pregnancy complications (Hayes, 2004). Ultrasonography is the imaging tool of choice for evaluation of appendicitis, followed by CT or magnetic resonance imaging (MRI) for equivocal findings. The sensitivity of ultrasonography is decreased in centers where it is used less often, when the appendix is not clearly visualized, and when there is shorter duration of pain; sensitivity is also dependent on the child's body habitus (Mittal *et al*., 2013).

- **Nuclear Medicine Imaging:**

Nuclear medicine uses small amounts of radioactive material to create images of internal structures and to identify abnormalities, such as tumors or infections. This modality is also used to diagnose and monitor certain diseases such as cancer, heart diseases, and thyroid diseases (Islam *et al*., 2023).

Electrical Impedance Tomography (EIT):

EIT imaging uses electrical signals to image internal structures and monitors changes in their electrical properties, such as the lungs and heart (Brown, 2003).

- **Cardiovascular Imaging**

It is a subspecialty of Medical imaging that uses various modalities to visualize the structure and function of the heart and blood vessels. It includes techniques such as Echocardiography, Cardiac Computed Tomography (CCT), and Magnetic Resonance Imaging (CMR). These techniques help in the diagnosis of heart diseases, such as Coronary artery disease, valvular heart disease, and congenital heart disease. They also play an important role in guiding interventional procedures such as angioplasty and stent placement (Islam *et al*., 2023).

Abdominal Ultrasonography of the Pediatric Gastrointestinal Tract

Ultrasound is an ideal imaging modality in the pediatric population because it is a real-time, non-invasive, relatively low cost examination without ionizing radiation that requires no sedation. Several recent reviews have emphasized the utility of ultrasound in the evaluation of pediatric bowel pathology (Arys *et al*., 2014). Ultrasound of the bowel in children is typically a targeted examination, designed to answer a specific question, and common indications include evaluation for appendicitis, intussusception, and pyloric stenosis. Other focused examinations include evaluation of congenital abnormalities detected prenatally, confirmation of suspected hernia, and problem solving in the patient with necrotizing enterocolitis (NEC). Unsuspected bowel abnor- malities may be found during screening for non-specific abdominal pain, including foreign body, tumor, infection, or bowel hematoma. A more comprehensive examination of the entire bowel is used at some centers to evaluate inflammatory bowel disease (IBD) (Gale *et al*., 2016), and celiac disease in children (Lupu *et al*., 2014; Bartusek *et al*., 2007).

Role of Ultrasound in the Abdomen:

The abdominal cavity consists of many organ-like kidneys, gallbladder, pancreas, liver, intestine etc. When the patients come to the hospital with abdomen pain. Diagnose of the patient with abdomen pain finds by imaging technology like ultrasound, computerized tomography, Magnetic resonance imaging, etc. Abdominal ultrasound the Diagnose of the cavum with abdomen symptoms. Ultrasound is additionally useful for the Diagnose of solid organ conditions including acute cholangitis, acute cholecystitis, acute pancreatitis, or bowel disease. CT is that the 1st line procedure suggests to the patient but CT is an invasive procedure or high-cost price but USG is a non-invasive procedure or cheap cost so that we preferred USG for the suspected patient. During this case, abdominal ultrasound is that the 1st line procedure to judge its utility and limitation in determining the Diagnose of patients presenting with abdominal symptoms (Fazel *et al*., 2019).

- **USG Role in Kidney:**

Renal calculi are a common reason for hematuria likewise as abdominal pain. High speed & portability has made USG the primary diagnostic in many clinical conditions. The accuracy of USG is very obsessed with the talents of the operators. Advancement of USG equipment in recent year have improved the standard of image, especially the spatial resolution (Kumar *et al*., 2022).

USG role in Gallbladder:

Cholelithiasis is the most common condition of GB. GB which results in liver abscess may be a rare complication of acute, chronic, or empyema gallbladder. USG scan is the foremost important diagnostic tool to Diagnose during this rear complication (Rikki *et al*., 2011).

USG Role in Pancreas:

USG of the pancreas is challenging, its retroperitoneal location with overlying structure and comparatively small size. The standard thereby the clinical uses of the pancreatic USG imaging has rapidly advanced together with the technological progress. The sensitivity and specificity of Trans abdominal USG within the Diagnose of pancreatic diseases. The flexibility to the difference between acute and chronic inflammation and premalignant or malignant (Kumar *et al*., 2022). USG role in acute appendix: USG is a crucial clinical tool to diagnose appendicitis. Acute appendicitis is the most typical emergency presentation requiring surgical intervention in both adults and kids. The simplest imaging modality or combination of modalities to accurately and cost-effectively diagnose the condition. Sonographic criteria or techniques that improve accuracy and assist Diagnose would be of particular benefit in appendicitis (Reddan *et al*., 2016)

Abdominal Anatomy

Ultrasound imaging of the abdomen uses sound waves to form the image of structure within the abdomen. It evaluates the kidney, liver, gall bladder, bill duct, pancreas, spleen, and aorta. The abdomen is divided into 4 quadrants or 9 regions by two sagittal plans and two transverse plans. The umbilicus server at the center of the nine regions each region and its associated organ well (Figure 1) (Kumar *et al*., 2022).

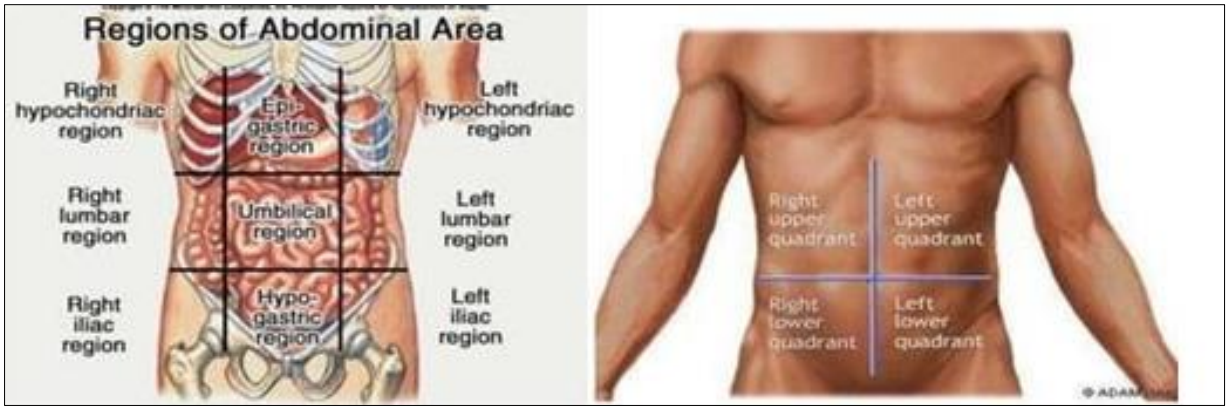

Figure 1: The anatomy of abdominal by quadrants and regions

Normal Anatomy

Normal bowel loops have a stratified pattern on high resolution ultrasound with the following 5 layers: Mucosal interface with lumen (hyperechoic), mucosa (hypoechoic), submucosa (hyperechoic), muscularis (hypoechoic) and serosa (hyperechoic). Typically, however, only 2 layers are visible on ultrasound, including an inner hyperechoic layer and outer hypoechoic layer. In normal children, small bowel loops are compressible, show minimal vascularity, and have wall thickness <2.5 mm. Jejunal loops have more folds and peristalse more than ileum, and the colon contains more air, fewer folds, and wall thickness is < 2 mm (Biko *et al*., 2015).

Pathogenesis

Abdominal pain may be classified as visceral, so matoparietal, and referred pain according to the nature of the pain receptors involved. Interestingly, most abdominal pain is associated with visceral pain receptors (Ross & LeLeiko, 2010). Visceral pain receptors are located on the serosal surface, in the mesentery, within the intestinal muscle, and the mucosa of hollow organs. These pain receptors respond to mechanical and chemical stimuli, such as stretching, tension, and ischemia. Because visceral pain fibers are unmyelinated C-fibers, and enter the spinal cord bilaterally at several levels, visceral pain is usually dull, poorly localized, and perceived in the midline. In addition, there are three broad pain areas with anatomic associations. Pain emanating from foregut structures (e.g., lower esophagus, stomach) is felt in the epigastric area, pain from midgut structures (e.g., small intestine) is felt in the periumbilical area, and pain from hindgut structures (e.g., colon) is felt in the lower abdomen. Somatoparietal pain receptors are located in the parietal peritoneum, the muscle, and the skin. Pain resulting from inflammation, stretching, or tearing of the parietal peritoneum is transmitted through myelinated A-δ fibers to specific dorsal root ganglia. Somatoparietal pain is characterized by sharp, more intense, and more localized sensation. Movement may aggravate the pain; thus, the child will stay still. Referred pain is well localized but felt in distant areas of the same cutaneous dermatome as the affected organ. It results from shared spinal cord level for afferent neurons from different sites. For example, inflammatory conditions that affect the diaphragm can be perceived as pain in the shoulder or lower neck area (Leung & Sigalet, 2003).

Etiology

A wide range of surgical and non-surgical conditions can cause acute abdominal pain in children. A brief discussion of some life-threatening and common causes of acute abdominal pain follows. Life-threatening causes of abdominal pain often result from hemorrhage, obstruction, or perforation of the gastrointestinal tract or intra-abdominal organs, and may be associated with

specific clinical features (Grant *et al*., 2008). Extra-abdominal causes of abdominal pain (e.g., diabetic ketoacidosis, hemolytic uremic syndrome, and myocarditis) also have other distinguishing clinical features. Common causes of abdominal pain include gastroenteritis, constipation, systemic viral illness, infections outside of the gastro intestinal tract (e.g., streptococcal pharyngitis, lower lobe pneumonia, and urinary tract infection), mesenteric lymphadenitis, and infantile colic (Carty, 2002).

- **Acute Appendicitis**

Acute appendicitis is the most common surgical cause of acute abdominal pain in children. Typically, children with appendicitis present with visceral, vague, poorly localized, periumbilical pain. Within 6 to 48 hours, the pain becomes parietal as the overlying peritoneum becomes inflamed. The pain manifests itself as a well-localized pain in the right lower quadrant. However, some of these characteristic manifestations are frequently absent, particularly in younger children. Therefore, physicians should consider the diagnosis of appendicitis in all cases of previously healthy children who have a history of abdominal pain and vomiting, with or without fever or focal abdominal tenderness (Kim., 2013).

Appendicitis is the most common general surgical emergency worldwide and is a cause of significant morbidity and mortality, particularly in the developing world. Its presentation and management is not always straightforward. The signs and symptoms are often non-specific and can mimic other pathology which adds to the complexity and challenges of making the correct diagnosis. With the aid of imaging, scoring systems and a broader range of treatment options, contemporary management of appendicitis is becoming more sophisticated and precise (Dixon & Singh, 2023).

- **Abdominal Trauma**

Abdominal trauma may cause hemorrhage or laceration of solid organs, bowel perforation, and organ ischemia from vascular injury, and intramural hematoma. Blunt abdominal trauma is more common than penetrating injury. Typical mechanisms of trauma include motor vehicle accidents, falling down, and child abuse (Garbuzenko, 2023).

- **Intestinal Obstruction**

Intestinal obstruction may produce a characteristic cramping pain. This clinical feature is usually associated with serious intra-abdominal conditions that require urgent diagnosis and treatment. Causes of intestinal obstruction include intussusception, malrotation with midgut volvulus, necrotizing enterocolitis, incarcerated inguinal hernia, and post-operative adhesions (Carty, 2002).

- **Gastroenteritis**

Acute gastroenteritis is defined as diarrheal disease of rapid onset, with or without nausea, vomiting, fever, or abdominal pain. It involves increased stool frequency or altered stool consistency that is unrelated to chronic conditions. Worldwide, 68% of diarrheal disease occurs in young children. Diarrheal disease is the fifth leading cause of death in children worldwide, accounting for about 2.5 million deaths. (Hartman *et al*., 2019). Viruses including rotavirus, Norwalk virus, adenovirus, and enterovirus are the most frequent causes. Bacteria and parasites can also cause acute abdominal pain in children. (Kim., 2013)

- **Constipation**

Children with constipation often present with fecal impaction and severe lower abdominal pain. Constipation is likely in children with at least two of the following characteristics: fewer than three stools weekly, fecal incontinence, large stools palpable in the rectum or through the abdominal wall, retentive posturing, or painful defecation (Matsumoto *et al*., 2022; Loening-Baucke & Swidsinski, 2007).

- **Infantile Colic**

Infants with colic, particularly those with hyper tonic characters, may have severe abdominal pain. Typically, infants with colic show paroxysmal crying and draw their knees up against their abdomen. Colic is relieved with the passage of flatus or stool during the first three to four weeks of life (El Hasbaoui *et al*., 2018; Kim., 2013).

- **Intussusception**

When aproximal segment of the intestine telescopes into the lumen of a distal section, this occurs. The intussusception usually occurs in the ileocecal region. Infants between the ages of 3 and 12 months are most commonly affected. The incidence is highest between the ages of 5 and 7months (Bradshaw *et al*., 2018).

Inflammatory Bowel Disease

This category includes ulcerative colitis and Crohn's disease. Ulcerativecolitis; affects the rectum and expands proximally, with are lapsing, remitting course and diffuse inflammation of the intestinal mucosa (Bradshaw *et al*., 2018).

2. Objectives of the Study

This study aimed to:

1. To analyze the use and limitations of abdominal sonography for acute abdominal pain in the pediatric age group.
2. To assess the clinical indication for requesting an ultrasound for a patient with a history of abdominal pain.

3. METHODOLOGY

3.1. Method and Patients

This was a retrospective descriptive observational study conducted among all pediatric age group patient who had done ultrasound for acute abdominal pain in radiology department at Benghazi Children's Hospital attended in a period of study from February 2023 to September 2023.

3.2. The Data Collection

In this study, a total of 108 children with acute abdominal pain attend for abdominopelvic ultrasound scan. The data collected using a pre-structured questionnaires including: The age, gender, site of pain, onset of pain, , duration of pain, associated symptoms, ultrasound findings and diagnosis. The patients were examined by Grey-Scale Ultrasonography (U/S). No need for any specific preparation. The patients examined with a 3.5 MHZ curvilinear transducer and a sony printer utilizing thermal paper, an ultrasound machine (Risingmed, model: RUS 6000D) was used.

3.3. The Inclusion and Exclusion Criteria

Children were selected on the basis of strict inclusion criteria. Children of both gender presented with acute onset abdominal pain (acute abdominal pain is defined as pain of nontraumatic source with maximum duration of 5 days), On other hand children presented with chronic pain with other co-morbidities were excluded from this study.

3.4 Statistical Analysis

The collected data were coded, entered, double-checked, analyzed, and statistically presented using the software statistical package (SPSS), version 22 (SPSS, Chicago, IL, USA). Data were summarized using mean, standard deviation, median in quantitative data, and using absolute frequency (count) and relative frequency (percentage) for categorical data.

4. RESULTS

4.1The Demographics of the Study Sample:

4.1.1Gender:

A total of 108 children were presented through the Radiology Department during the period of data collection. The male patients (59, 54.6%) were higher in frequency than the female patients (49, 45.4%). (Figure 2).

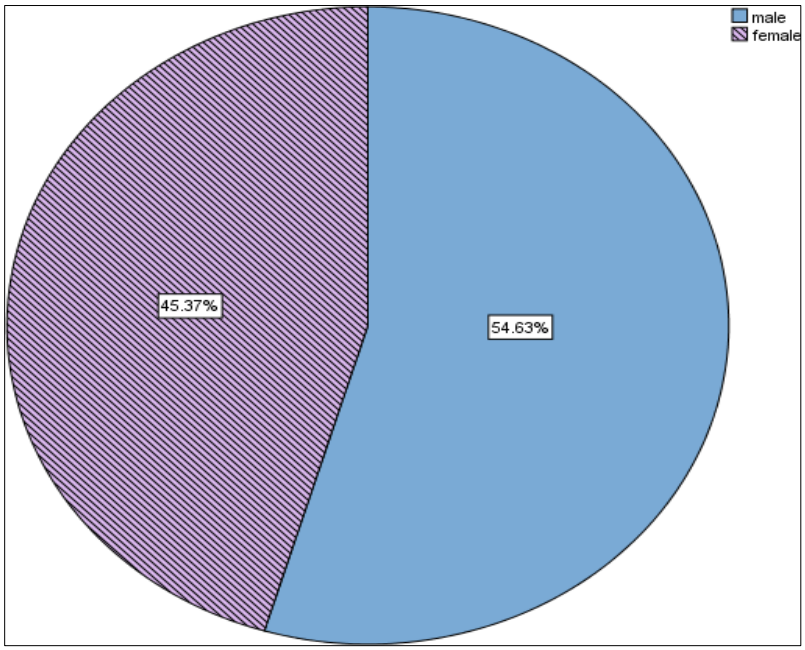

Figure 2: The distribution of the patients according to gender

4.1.2 Age:

The mean age of children included in the study sample was (7.71 ±3.66 years SD) with a minimum age of five months and a maximum age of 14 years old. The median age of the children was eight anda bout (32, 29.6%) fall in the age group (6-8 years), followed by the next older age group (9-11years) that constituted about 26% of the study sample (28 children). The age groups more than twelve years and (3-5years) constituted (21,19.4%) and (15,13.9%) respectively . lastly it was the most younger age group ≤ two years old that was the least presented of having the complain of acute abdominal pain in the study sample. (Figure 3).

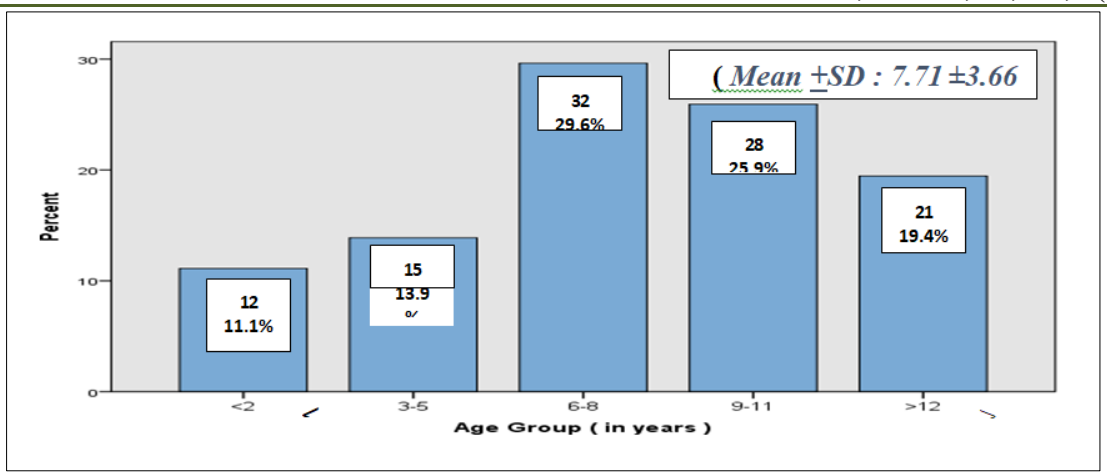

Figure 3: The distribution of patients according to age groups.

4.1.3 The Pain Site:

The sites of the pain among the patients were widely distributed all across the anatomical abdominal areas. The highest number of cases (44, 40.7%) came with pain in the right hypochondria, followed by eighteen cases who localized the umbilical area as the site of pain (16.7%).about 14% of the patients didn't localized a specific site for their pain (15 patient). Data presenting frequency and percentage of pain according to other abdominal areas in figure (1) is showed in table (1).

Table 1: The distribution of pain according to the site

Regions of Abdominal area		Frequency (N)	Percent (%)
Un localized	Generalized	15	13.9
central	Epigastric	13	12.0
	umbilical	18	16.7
	Hypogastrium (Suprapupic)	7	6.5
Right side	Rt.hypochondrium	44	40.7
	Rt. lumber	3	2.8
	Rt. iliac fossa	2	1.9
Lt side	Lt. lumber	5	4.6
	Lt. iliac fossa	1	0.9
Total		108	100

Rt :Right,Lt: Left.

For more clarification of the distribution of pain according to the abdominal anatomical areas, the segments was divided longitudinally into central, right, and left areas and the combined numbers were presented in the figure(4). It showed that the Right area (Rt.hypochondrium, Rt. Lumber and Rt. iliac fossa) constituted the higher distribution (49.45%) followed by the central area (Epigastric ,Umbilical and hypogastrium) that constituted 35.2 % (38 patients).figure(4)

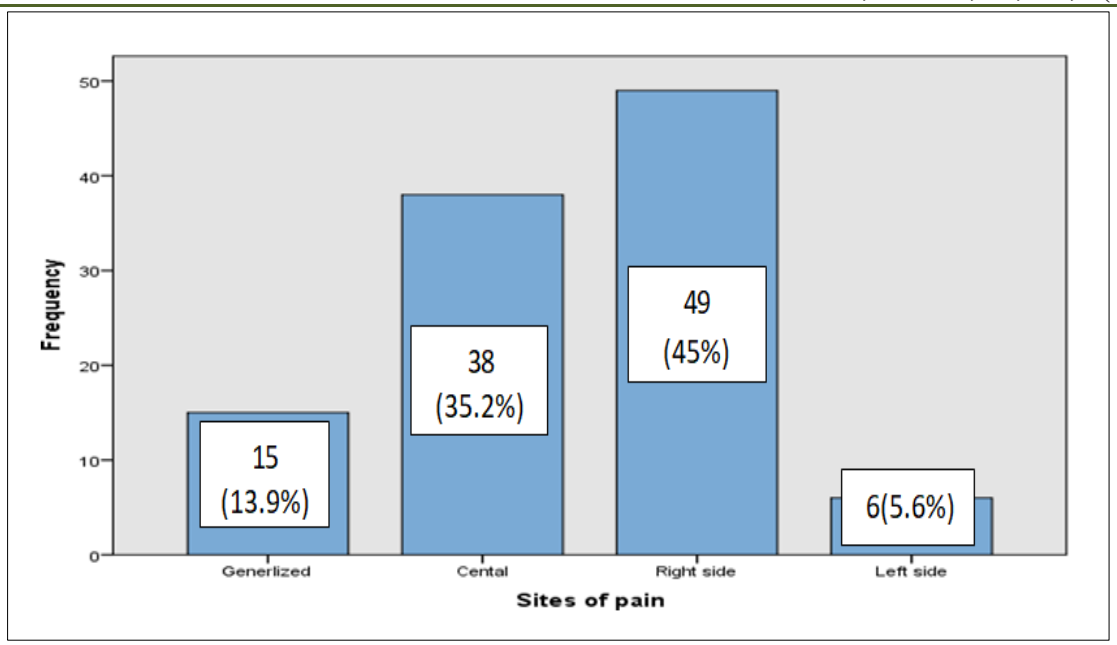

Figure 4: The distribution of patient according to the site of pain

4.1.4 The Symptoms:

The cases of acute abdominal pain included in the study exhibited a range of symptoms. Fever was the most prevalent symptom, occurring in 67 cases (62%). Over 20% of the patients experienced vomiting (22 cases, 20.4%), while diarrhea appeared as a related symptom in approximately 19% of the cases (20 cases). Distention and urinary issues accounted for a smaller fraction of the total, with rates of 16 cases (14.8%) and 10 cases (9.3%), respectively. The remaining cases showed constipation and weight loss, each affecting about 4% of the total sample (4 cases). (Table 2)

Table 2: The distribution of the pain according to symptoms

Symptoms*	Frequency (N)	Percent (%)
Fever	67	**62**
Vomiting	22	**20.4**
Diarrhea	20	**18.5**
Distention	16	**14.8**
Urinary symptoms	10	**9.3**
Constipation	4	**3.7**
Weight loss	**4**	**3.7**

*Multiple response variable

4.1.5 The Ultrasound Diagnosis:

Out of 108 cases, 21 children had normal ultrasound findings (19.4%). Other diagnoses made according to the ultrasound findings included the following in descending order according to frequency: the Mesenteric Lymphadenitis was diagnosed in more than one third of cases (30,27.8%), also nearly equal portion of cases were diagnosed with appendicitis (26,24.1%), other less commonly diagnoses constituted collectively about (14,13%), where the diagnosis of intussusception, perforated appendix, urinary tract infections, and appendicular mass constituted (8,7.4%),(6,5.62%) ,(2,1.9%), (1,0.9%) respectively. Table (3).

Table 3: The distribution of patients according to ultrasound diagnosis

Ultrasound Diagnosis	Frequency (N)	Percent (%)
Normal scan	21	**19.4**
Mesenteric Lymphadenitis	30	**27.8**
appendicitis	26	**24.1**
intussusception	8	**7.4**
perforated appendix	6	**5,6**
urinary tract infections	2	**1.9**
appendicular mass	1	**0.9**
others	**14**	**13**

LIST OF ABBREVIATIONS OR SYMBOLS

Abbreviation of symbols	Meaning
AUS	Advanced Ultrasound
CCT	Cardiac Computed Tomography
CMR	Magnetic Resonance Imaging
CT	computed tomography
DKA	Diabetic ketoacidosis
EIT	Electrical Impedance Tomography
FAP	Functional Abdominal Pain
FMF	Familial Mediterranean fever
GB	Gallbladder
GI	Gastrointestinal tract
HSP	Henoch-Schönlein Purpura
IBD	inflammatory bowel disease
MRI	magnetic resonance imaging
NEC	necrotizing enterocolitis
US / USG	Ultrasonography

5. DISCUSSION

Ultrasound is an ideal imaging modality in the pediatric population because it is a real- time, non-invasive, relatively low cost examination without ionizing radiation that requires no sedation (Gale *et al*., 2016). Ultrasound (USG) is a useful modality in evaluation of abdominal pain as it can be performed quickly and without risk of radiation exposure; however, there is a risk of its indiscriminate use in all cases of abdominal pain. Clinical discretion is therefore essential for judicious use. Ultrasound is useful in the diagnosis of appendicitis, intussusception and malrotation with volvulus (Iyer & Nallasamy, 2018). In our study, the distribution of acute abdominal pain among study population was slightly higher in males (59, 54.6%) than females (49, 45.4%). These results were comparable to the results of Banoub *et al*., (2021), that showed that male was a bit more frequent than female (56.6% versus 43.4% respectively). Similarly, Khalid *et al*., (2015) in their work stated that there were 82 male (57%) and 64 female (43%) pediatric patients. Most of the patients (74 in number – 50.7%) belonged to the age group of 9 to 12 years. Conversely, these results were different from the study of Yılmaz *et al*., (2015), as they found that of the patients, 88 (35%) were girls, 164 (65%) were boys, and their ages ranged from one to seventeen (with a mean age of 8.9 years). Also, these results were dissimilar to the results of Ramadan & Ali, (2020), which out of 280 children complaining of abdominal pain 125 (44.6 %) were male and 155 (55.4%) children were female, mean age 9.28 years ±2.92 (range = 1- 16 years). In the current study, the most common age group were (6-8) years. This results was different to the study of Banoub *et al*., (2021), which showed that the most common age group among the studied cross-section was older than 10 years; they represented about 38% of the studied patients. Also, these results dissimilar to Khalid *et al*., (2015) study in which most of the patients (74 in number – 50.7%) belonged to the age group of 9 to 12 years. In our study, the highest number of cases (49, 45%) came with pain in the Right side of abdomen (44 patient RT hypochondrium), followed by (38,35.2%) in central area(18 patient at umbilical area),and (15,13.9%) presented wih generalized pain,and (6,5.6%) the pain in Left side of abdomen. These findings were similar to the study of Khalid *et al*., (2015), that the abdominal pain in the umbilical area was seen in 19% of the patien ,different also to the study of Elrouby *et al*., (2022), that showed the most of the studied patients presented with right iliac fossa pain (n=24, 20%). In our study, the duration of acute abdominal pain among the cases taken days before the ultrasound was done. These results were similar to the work of Muhammad & Tariq (2015), that the results showed that the patients duration of pain was less than three days in 89% (134) of cases. In this study, beside to abdominal pain ,Fever was the most common associated symptom in the majority of cases (67, 62%), followed by vomiting (22, 20.4%), These findings were comparable to the study of Banoub *et al*., (2021), which revealed the most associated symptoms was vomiting (143, 69.8%) and fever (63, 30.7%). Also, these results similar to the study of Khalid *et al*., (2015), that besides pain, most common presentation in their study was vomiting (33%), followed by fever (21.9%) and constipation (14.7%). Also, Elrouby *et al*., (2022), in their work mentioned that all of the studied patients presented with abdominal pain ,and the vomiting was the most common associated symptom, then nausea, and fever were presented in equal ratio accounting (16, 13.3%) each. Also, in the study of Patel and Gedam, (2019), all patients came with few above half of the following symptoms in descending order: abdominal distention (57%), fever (54%) and vomiting (53%). These most common associated symptoms with acute abdomen. In our study 21 children had normal ultrasound findings (19.4%). Other diagnoses made according to the ultrasound findings included the following in descending order according to frequency : the Mesenteric Lymphadenitis (30,27.8%), appendicitis (26,24.1%),where the diagnosis of intussusception

,perforated appendix , urinary tract infections, and appendicular mass constituted (8,7.4%),(6,5.62%) ,(2,1.9%), (1,0.9%) respectively ,other diagnosis accounted (14, 13%)**.** These results not comparable to the study results of Khalid *et al*., (2015) where the single most common cause of pain was non-specific abdominal pain, which accounted for 44 cases (30%), and was followed by abdominal abscess (21%), acute appendicitis (7%) and intussusception (7%), respectively. The results were different from the following two studies, that in the Ramadan & Ali, (2020) study, the Functional Abdominal Pain represent the higher percentage of cases 92(32.9) followed by postoperative pain 52(18.6%), then urolithiasis 45(16.1%), then parasitic infestation 25(8.9%). mesenteric adenitis, hepatitis and FMF were (3.6%, 6.8% and 6.4% respectively). Intussusceptions and appendicitis were 3.2% and 1.4% respectively. While the lowest percentage was obtained in pancreatitis, gallbladder disease and ovarian cyst 2(0.7%). Also, in the work of Elrouby *et al*., (2022), the most common presentation was appendicitis (40 patients, 33.3%) followed by intussusception (16 patients, 13.3%) with different frequencies among different pathologies. Appendicitis represents the most common cause of acute surgical abdomen in the pediatric population. Furthermore, in the study of Patel and Gedam, (2019), the final diagnosis of acute abdominal pain patients were intestinal obstruction was most common cause (43%) of acute abdomen. Renal colic, pancreatitis and HSP were uncommon (1.3% each) cause. Appendicitis is present in 14.8% cases. Mesenteric lymphadenopathy is rare (only 4%) cause but in 25.6% cases causes were un-identified. Additionally, only 25% of cases who previously have newly been diagnosed with an acute abdomen actually undergo surgical treatment; consequently, the clinical challenge is whether the patients require surgical intervention or not, as well as whether the medical alternative must be made as rapidly as possible. This makes a careful and rational approach to stomach pain treatment (Elhaj, 2023).

6. CONCLUSION

Acute abdominal pain is a common but nonspecific manifestation of a variety of diseases in children, ranging from relatively benign mesenteric lymphadenitis or gastroenteritis to potentially lethal intussusception or perforated appendicitis. There is a considerable overlap in clinical signs and symptoms, and diagnosis often rests on imaging evaluation. There is no need for patient sedation and no ionizing radiation. Ultrasound is becoming an increasingly significant imaging technique for evaluating acute abdominal discomfort in pediatric patients. Ultrasound is the often the initial modality detecting abnormalities of the GI tract in children, either as part of a targeted exam at the site of symptoms or as an incidental finding. Radiologists interpreting US examinations in children should be familiar with the sonographic appearance of both the normal and abnormal GI tract in order to provide the best care for pediatric patients with abdominal diseases.

7. RECOMMENDATION

This research work recommended that

1. The USS tool should not be used as a routine role for diagnosis in any patients who came with abdominal pain.
2. The writing of a request should be improved by adding a full patient history, a full examination, and any investigations that have been done and are helpful.
3. The requesting of USS should be by senior to minimize overuse.
4. Limitations

This study has some limitations.

1. The results of ultrasound were obtained by a retrospective review of the radiological records.
2. The patients who presented with abdominal pain without undergoing sonography were not included.
3. The accuracy of diagnosis for pediatric abdominal pain by ultrasound depended on the experience of operator, that in evaluating the same patient two sonographers can obtain different information, thus formulating different diagnoses.
4. Finally, this study covered only the experience in one hospital. A future study in multiple medical centers for the evaluation of acute abdominal pain ultrasonographic in children is required.

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