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ORIGINAL RESEARCH

Utility of X ray abdomen and ultrasonography in children with chronic abdominal pain

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ABSTRACT

Aim: Abdominal pain is classified into visceral, somatoparietal, and referred pain based on the nature of the pain receptors involved. The majority of abdominal pain is associated with visceral pain receptors, which are located on the serosal surface, mesentery, intestinal muscle, and mucosa of hollow organs. Hence; the present study was conducted for assessing the utility of X ray abdomen and ultrasonography in children with chronic abdominal pain. **Materials and methods:** This retrospective analysis of prospectively collected data included 50 children aged 3–16 years with acute abdominal pain or tenderness and typical skin purpura, after excluding 15 cases due to incomplete records. Informed consent was obtained from parents for diagnosis, radiology, treatment, and anesthesia when necessary. Data collection covered demographic details, laboratory results, and imaging findings from X-ray and ultrasound. Data analysis was done using SSPS software. **Results:** Sensitivity, Specificity and Diagnostic accuracy of X-ray for assessing chronic abdominal pain was 76.5 percent, 72.9 percent and 75.9 percent respectively. Sensitivity, Specificity and Diagnostic accuracy of USG for assessing chronic abdominal pain was 83.6 percent, 85.1 percent and 88.9 percent respectively. **Conclusion:** USG had higher diagnostic accuracy of for assessing chronic abdominal pain among children.

Keywords: Abdominal, pain, ultrasonography

INTRODUCTION

Abdominal pain is classified into visceral, somatoparietal, and referred pain based on the nature of the pain receptors involved. The majority of abdominal pain is associated with visceral pain receptors, which are located on the serosal surface, mesentery, intestinal muscle, and mucosa of hollow organs.[1,2] These receptors respond to mechanical and chemical stimuli such as stretching, tension, and ischemia. Since visceral pain fibers are unmyelinated C-fibers that enter the spinal cord at multiple levels bilaterally, the pain is typically dull, poorly localized, and perceived in the midline. Furthermore, pain location corresponds to the embryologic origin of the organ involved: foregut structures (e.g., stomach, lower esophagus) cause epigastric pain, midgut structures (e.g., small intestine) cause periumbilical pain, and hindgut structures (e.g., colon) cause lower abdominal pain.[3]

In contrast, somatoparietal pain originates from pain receptors in the parietal peritoneum, muscles, and skin and is transmitted via myelinated A-δ fibers to specific dorsal root ganglia, making it sharp, intense, and well localized. This pain is often aggravated by movement, causing affected individuals to remain still.[5] Referred pain, on the other hand, is well localized but felt in a distant area sharing the same cutaneous dermatome as the affected organ due to overlapping spinal cord levels of afferent neurons.

In pediatrics, abdominal pain can be categorized as either acute or recurrent. Acute abdominal pain refers to sudden, severe, and persistent pain that may necessitate surgical intervention. In contrast, recurrent abdominal pain, as defined by Apley, is characterized by at least three episodes of pain occurring over three months within the past year. Epidemiological studies indicate that 10-12% of boys aged 5-10 years experience abdominal pain, though its prevalence

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declines with age. Notably, functional abdominal pain is more common in girls than boys, with a prevalence of 15.9% versus 11.5%, respectively.[6,7]In this study we aimed to assess the utility of X ray abdomen and ultrasonography in children with chronic abdominal pain.

MATERIALS AND METHODS

This retrospective analysis of prospectively collected data included 50 children aged 3–16 years with acute abdominal pain or tenderness and typical skin purpura, after excluding 15 cases due to incomplete records. Informed consent was obtained from parents for diagnosis, radiology, treatment, and anesthesia when necessary. Data collection covered demographic details, laboratory results, and imaging findings from X-ray and ultrasound.

Imaging assessments focused on intestinal segment dilation, motility, intramural hemorrhage, and small bowel wall changes. X-rays and ultrasounds were conducted by gastroenterologists with at least three years of experience. Decision curve analysis evaluated the beneficial score and working area for each imaging modality, with the working area representing the likelihood of detecting abdominal purpura. Sensitivity was measured as the proportion of true positive cases identified by each imaging technique against those confirmed by the ACR criteria, while accuracy reflected the proportion of true negative cases. Data analysis was done using SSPS software.

RESULTS

Table 1: Laboratory test results.

Test	Normal values	Test results	Test prediction
Hemoglobin, g/dl	12-15	12.5±1.02	Normal
Total leucocyte, count/µl	4500-11,000	12,242 ±132	Abnormal
Platelet, count/µl	1,50,000-4,50,00	321,641±5,541	Abnormal
Serum amylase, IU/l	23-85	159±29	Abnormal
Urine amylase, IU/l	20-400	1,102±80	Abnormal
Erythrocytes sedimentation rate, mm per the first hour	12-20	25.28 ± 10.62	Abnormal

The hemoglobin levels were within the normal range (12.5±1.02 g/dl), while the total leucocyte count (12,242±132/µl), platelet count (321,641±5,541/µl), serum amylase (159±29 IU/l), urine amylase (1,102±80 IU/l), and erythrocyte sedimentation rate (25.28±10.62 mm in the first hour) were elevated, indicating abnormal results.Sensitivity, Specificity and Diagnostic accuracy of X-ray for assessing chronic abdominal pain was 76.5 percent, 72.9 percent and 75.9 percent respectively. Sensitivity, Specificity and Diagnostic accuracy of USG for assessing chronic abdominal pain was 83.6 percent, 85.1 percent and 88.9 percent respectively.

Table 2: Diagnostic accuracy of X-Ray and USG in identifying etiology of chronic abdominal pain

Variable	X-ray	USG
Sensitivity	76.5	83.6
Specificity	72.9	85.1
Diagnostic accuracy	75.9	88.9

DISCUSSION

Chronic abdominal pain in children is a common clinical concern with a wide range of potential causes, including functional disorders, gastrointestinal conditions, and systemic diseases. Imaging modalities such as X-ray abdomen and ultrasonography play a crucial role in evaluating these patients by aiding in the identification of underlying organic pathology. X-ray abdomen is often used as an initial investigation to detect bowel obstruction, constipation, or abnormal gas patterns, while ultrasonography provides a more detailed assessment of soft tissue structures, offering valuable insights into conditions such as appendicitis, intussusception, and mesenteric adenitis. Ultrasonography is particularly advantageous in pediatric patients due to its non-invasive nature, lack of radiation exposure, and ability to provide real-time imaging. [8,9]

Sensitivity, Specificity and Diagnostic accuracy of X-ray for assessing chronic abdominal pain was 76.5 percent, 72.9 percent and 75.9 percent respectively. Sensitivity, Specificity and Diagnostic accuracy of USG for assessing chronic abdominal pain was 83.6 percent, 85.1 percent and 88.9 percent respectively. A study by Ge Y et al.[10] aimed to compare the diagnostic accuracy of ultrasound, X-ray, and computed tomography (CT) for detecting abdominal purpura in children with acute abdominal pain, Medical records of 215 children were reviewed, analyzing clinical data, laboratory tests, and imaging findings. CT demonstrated the highest sensitivity (0.939), while ultrasound had the highest overall accuracy (0.861). Unlike X-ray and laboratory tests, ultrasound and CT effectively identified abdominal purpura in children with colicky pain under 20 years old, even when biopsy and occult blood stool tests were negative. Ultrasound had seven inconclusive results, while CT had three. The study concluded that abdominal ultrasound is a simple, non-invasive, and reliable tool for diagnosing abdominal purpura in children.

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Kubiszewski K et al.[11] conducted a study to evaluate the diagnostic yield of abdominal radiographs (ARs) in assessing intraabdominal pathology in the pediatric emergency department (PED). Among 4,288 ARs performed (6% of visits), 31% were abnormal, with higher rates in patients with constipation (50%), vomiting (37%), and abdominal pain (26%). Clinically significant diagnoses were identified in only 13% of cases. ARs demonstrated 44% sensitivity, 70% specificity, 17% positive predictive value, and 90% negative predictive value ($P < 0.05$). Odds ratio analysis indicated a weak association between positive AR findings and abdominal pain (OR 0.68, 95% CI: 0.63-0.75) but stronger associations with vomiting (OR 1.22, 95% CI: 1.06-1.39) and constipation (OR 1.72, 95% CI: 1.54-1.91). The study concluded that ARs had limited diagnostic value in the PED, as they rarely altered patient management or reduced the need for further imaging.

Ramachandran P, et al.[12] conducted a study to assess the sensitivity and specificity of abdominal ultrasonography in diagnosing appendicitis in 452 children (average age 11 years). In the first 18 months, all suspected cases underwent ultrasound (Group I, 180 patients), while in the following 30 months, ultrasound was performed only in equivocal cases (Group II, 272 patients). A positive scan was defined by an enlarged noncompressible appendix (>6 mm), a complex mass, or an appendicolith. Appendicitis was confirmed in 112 cases, including 17 with perforation. Overall, ultrasonography demonstrated 90% sensitivity, 96% specificity, and 95% accuracy. There were 11 false-negative cases, all managed with uncomplicated appendectomies, and 11 false positives, resulting in a negative laparotomy rate of 8.9%. Sensitivity and specificity remained consistent between the two groups (88% and 96% in Group I; 92% and 97% in Group II). The findings suggested that ultrasonography was a valuable adjunct in diagnosing acute appendicitis due to its high accuracy.

Scammell S et al.[13] conducted a retrospective study to evaluate the accuracy and usefulness of ultrasonography in diagnosing acute appendicitis in a regional pediatric surgical institution. Data from radiology, theater, and histopathology databases over a two-year period were cross-referenced. Among 273 non-incidental appendicectomies performed, the negative appendicectomy rate was 16.5%, and the perforation rate was 23.7%. Pre-operative ultrasound was conducted in 39% of cases, demonstrating a sensitivity of 83.3%, specificity of 97.4%, positive predictive value of 92.1%, and negative predictive value of 94.0%. The study found that ultrasonography was widely used for evaluating equivocal and complex cases, offering high diagnostic accuracy. Its strong negative predictive value indicated potential for more outpatient management in patients with negative scans.

A limitation of our study is the small sample size, which may affect the generalizability of the findings. Variability in results could also occur due to individual patient differences, necessitating larger studies to validate our conclusions.

CONCLUSION

USG had higher diagnostic accuracy of for assessing chronic abdominal pain among children.

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