

Research Article

Integrated Ultrasonic Diagnostics of Acute Appendicitis and its Complications in Children

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ABSTRACT

Complex sonography has proven itself in wide clinical practice in the study of children with acute abdominal pain, including pain in the right iliac region to exclude or confirm acute appendicitis, and also serves for differential diagnosis with diseases of the liver, kidneys and pelvic organs. The diagnostic efficacy indicators obtained in this study indicate the high specificity of ultrasound semiotics of acute appendicitis and its complications. In general, high diagnostic efficacy of ultrasound imaging was made possible through the use of a combination of a grayscale regime with color Doppler blood flow mapping techniques. Studying the features of the course of various clinical forms of acute appendicitis in children has made it possible to increase the effectiveness of diagnosis and improve treatment outcomes. Timely surgical interventions performed as a result of effective ultrasound examination will reduce the number of postoperative complications and reduce the time of treatment and rehabilitation of children undergoing appendectomy. The use of effective criteria for the ultrasound diagnosis of acute appendicitis in children will reduce the number of unreasonable surgical interventions in cases where the cause of acute abdominal syndrome is a different pathology of the gastrointestinal tract, and not acute appendicitis.

Keywords: Vermiform Appendix, Ultrasound Diagnostics, Dopplerography, Acute Appendicitis, Complications of Acute Appendicitis.

RELEVANCE OF THE STUDY

Acute appendicitis is by far the most common disease of the abdominal organs and occurs in 2-5 people per 1,000 [1]. In the Republic of Uzbekistan, this indicator is 3.05 people per 1000 population [2]. Diagnostic errors in this disease range from 15 to 25% and higher, and in many medical institutions the number of removed unchanged vermiform appendixes still reaches 20-30% [3]. The peak incidence of acute appendicitis falls at the most able-bodied age, and the number of appendectomies in the country annually exceeds 1 million, therefore, only 3 - 3.5 thousand people die every year from complications frolic in patients with acute appendicitis [4]. This category includes patients of childhood, women during pregnancy, the elderly and patients with an atypical arrangement of the appendix. In such situations, evaluating only the clinical picture of patients is clearly not enough [5]. Late diagnosis of acute appendicitis leads to serious complications: perforation of the appendix, peritonitis, retroperitoneal phlegmon, etc. [6, 7, 8]. Mortality from acute appendicitis in children averages 0.2-0.4% [9]. However, in the younger age group (children under 5 years of age), mortality is almost not reduced and is ten

times higher than the average level. The degree of reliability of the diagnosis of acute appendicitis, according to the clinical picture, is 75% [7]. Thus, clinicians continue to search for reliable additional instrumental methods for the timely diagnosis of acute appendicitis; non-invasiveness of the method is an additional requirement. The most acceptable in this regard is an ultrasound examination with such advantages as: the absence of contraindications, wide availability, mobility (the ability to perform under different conditions), the possibility of dynamic monitoring, the absence of radiation exposure, non-invasiveness [7]. However, to date, the opinions of experts on the effectiveness of ultrasound in establishing inflammatory changes in the appendix are ambiguous, mainly in the study of patients at an early stage of the development of the disease, including in the presence of a concomitant pathology of the abdominal organs. In addition, the possibilities of the method in the timely establishment of various forms of inflammation of the appendix are not well understood [10]. Thus, the difficulties and ambiguous approaches in the diagnosis of acute appendicitis and its complications in children require the improvement of clinical protocols and

standards for the use of complex ultrasound studies.

PURPOSE OF THE STUDY

Improving the diagnosis of acute appendicitis and its complications in children by using modern ultrasound studies.

MATERIAL AND RESEARCH METHODS

The paper presents the results of a study of 139 children with acute appendicitis who were treated at the clinic of the Tashkent Pediatric Medical Institute in 2019. The main contingent of patients was between the ages of 8 and 17, girls predominated - 75 (53.7%), boys were 64 (46.3%) with all forms of acute appendicitis, 17 of them with catarrhal form of acute appendicitis (12.5%), with phlegmonous - 83 (59.4%), with gangrenous - 39 (28.1%) children. Children with acute appendicitis were admitted to the hospital with complaints lasting up to 12 hours -38 (27.6%), from 12 to 24 hours -31 (22.4%), from 24 to 48 hours -31 (21.6%) and from 48 hours or more -39 (28.4%) children. The data obtained indicated that the form of acute appendicitis depended on the timing of admission to the hospital. In the first 12 hours from the onset of clinical manifestations of the disease, with a catarrhal form of acute appendicitis there were 94.1% of children, with phlegmonous - 23.5% of children, with gangrenous form - 5.6% of cases. In the next 12 hours, there was a decrease in the catarrhal forms of acute appendicitis to 5.9%, an increase in the destructive forms of acute appendicitis to 38.9%. In children with a disease duration of more than a day, only destructive forms of inflammation of the appendix were recorded. After 24 hours from the onset of clinical manifestations, 43.2% of children with phlegmonous appendicitis and 88.9% of children with gangrenous appendicitis arrived. Echo graphic studies were performed on ultrasonic diagnostic apparatuses "SONOSCAPE S22", "APLIO 500", high-frequency linear and convex sensors 5 - 7.5 MHz and higher (up to 13.5 MHz), which provided a wide view. The study was carried out in the position of the patient lying on his back, using the method of dosed pressure with an ultrasonic sensor according to Puylaert (1986) [11], which was carried out according to the type of classical abdominal palpation. In addition to the ability to find the exact projection of the inflamed appendix due to increased pain, dosed pressure had other advantages. In this case, the displacement and compression of the underlying loops of the intestine and fatty tissue occurred, which eliminated the influence of gas and other structures on the image quality. Also,

when using this technique, the distance between the sensor and the appendix is reduced, making it possible to use a high-frequency sensor to obtain a good image.

RESULTS AND DISCUSSIONS

We observed 154 patients with suspected acute appendicitis. Of these, 139 confirmed the diagnosis by the results of surgical intervention and morphological studies of the drug.

In 15 patients, the diagnosis of acute appendicitis was ruled out due to the presence of other acute abdominal diseases. So, ovarian apoplexy was observed in 3 girls, pelvic pain syndrome caused by various gynecological diseases in 5 girls, acute pancreatitis with diffuse pain in 2 children, an attack of renal colic on the right in 5 children. Of 139 children, acute catarrhal appendicitis was diagnosed clinically and echographically and morphologically in 17 (12.5%), phlegmonous in 83 (59.4%), and acute gangrenous with perforation of the appendix wall (12 observations). In 17 observations, empyema of the appendix was revealed, in 9 appendicular infiltrates, in 15 periappendicular abscesses, in 4 inter-intestinal spread of the inflammatory process. The accumulated experience allowed us to systematize direct and indirect echographic signs of acute appendicitis, depending on the form of the disease and its complications. In this case, the following direct and indirect signs of acute appendicitis were noted. In acute catarrhal appendicitis, we attributed the possibility of visualization of changes in the appendix to direct echographic signs. It was displayed on echograms in the form of a tubular structure when examined in a craniocaudal projection. Unlike the unchanged vermiform appendix, during the development of acute inflammation, the visualized appendix emanating from the cecum did not have peristaltic movement, the next important sign was the thickening of the appendix width of more than 6 mm (in our observations, from 5.5 to 9 mm) with a simultaneous increase its thickness is more than 2 mm. At the same time, the wall layers remained preserved. One of the signs that we noticed was a clear identification of the contours of the surface of the organ. This phenomenon, apparently, can be explained by the fact that already in the first hours of the development of the inflammatory process, edema-swelling occurs around the vermiform process, which echographically creates a contrast of the visualized surface.

With local compression by the sensor on the area of the visualized area, we observed rigidity of the appendix, which was one of the indirect signs of acute appendicitis. The weakening of peristalsis in

the terminal part of the small intestine also served as an indirect sign of the catarrhal form of acute appendicitis. A single increase in vascular pattern was noted with color Doppler mapping and energy Doppler ultrasound in only 9 cases and they were not always recorded in the first 6 hours from the onset of clinical symptoms.

Phlegmonous appendicitis was characterized by a further increase in the diameter of the appendix (up to 11 mm) and its wall thickness up to 5 mm. Due to the emergence of multilayer walls, the contrast between the mucosa, muscle layers and the serous lining intensified. Anechogenic contents were visualized in the cavity of the appendix. They were especially pronounced during blockade of the appendix by coprolites and during compression marked rigidity was noted. Indirect signs of this form of the disease were the presence of adhesions with the omentum and / or with a loop of the small intestine. In a number of cases (6 observations), mesentery infiltration was noted, which is displayed during ultrasound imaging in the form of a limited zone of increased echogenicity behind an inflamed appendix. The identification of fluid accumulation around the appendix is one of the important signs of phlegmonous appendicitis. In the modes of color and energy Doppler mapping, the intraparietal blood flow of the appendix was displayed as a numerous color mosaic. V.N. Piskunov et al. [12], note that Doppler signals during transverse scanning of the vermiform appendix appear as "color" crowns, and in longitudinal scanning, as "color tracks". The gangrenous form of acute appendicitis is characterized primarily by a violation of the integrity of the wall in any area with the development of inflammatory thickening of the cecum dome. In these cases, the layers of the walls of the appendix are practically not differentiated and are often traced in separate areas. The width of the appendix in the visualized area reaches more than 10 mm. And its wall thickness is more than 4 mm.

Destructive changes in all layers were displayed in the form of hypoechoic areas with isoechoic and hyperechoic layers depending on the development of degenerative-destructive changes. During compression of the appendix, its complete rigidity was noted. The accumulation of fluid, in contrast to the phlegmonous form, was significant and it spread to the pockets of the abdominal cavity and small pelvis.

In color Doppler mapping and energy Doppler ultrasound, along with an increase in vascular pattern in the vermiform appendix, enhanced blood flow was detected in adjacent loops of the intestine. The nature of changes in the vascular

pattern with phlegmonous form increased in dynamics. Therefore, in clarifying the phlegmonous form, periodic echographic observations are important, which when delaying surgery for objective or subjective reasons can assess the transition to the gangrenous stage of the disease. With the gangrenous form, 87.7% of cases revealed changes in the mesentery and omentum. In the projection of the location of the appendix, there was a separation of the peritoneum and accumulation of fluid in them. During empyema, the diameter of the appendix increased significantly and reached up to 16–20 mm. The structure of the process wall was characterized by heterogeneity, insufficient differentiation of the layers due to the pronounced destructive process. Contrast of adjacent bowel loops increased. Dopplerographic examination of the vessels did not reveal their pattern, as was observed with phlegmonous. It should be noted the transience of the development of empyema of the appendix, in our observations it developed within 36 - 56 hours from the onset of the disease. In cases of perforation of the appendix with phlegmonous or gangrenous forms, separation of the peritoneum leaves and thickening of the dome of the cecum were echographically observed. Destructive forms of acute appendicitis (phlegmonous and gangrenous) were often accompanied by perforation of the appendix wall, and in 17 children led to the development of complications, such as infiltrate, abscess, peritonitis, interintestinal abscesses, portal vein thrombosis. According to the generalized data of A.S. Ermolov and E.Yu. Trofimova [13] in addition to direct echographic diagnostic signs of acute appendicitis for its diagnosis, it is important to take into account and the totality of the following indirect signs:

- Thickening of the dome of the cecum;
- The presence of infiltrate in the area of the dome of the cecum;
- Increase the echogenicity of the tissues surrounding the cecum and the appendix;
- Increase the contrast of structures in the projection of the appendix of the caecum, distal small intestine, and surrounding tissues;
- Signs of peritonitis (gas outside the intestinal lumen);
- Absence, weakening or strengthening of peristalsis in the terminal part of the small intestine, anechogenic contents in the loops of the small intestine;
- An increase in the diameter of the distal ileum, thickening of the wall in the area of the ileocecal transition;

- The presence of free fluid in the right iliac region and pelvis [14, 15, 16].

Our studies have shown that errors in assessing the state of the appendix can occur both as a result of incomplete information obtained by ultrasound examination, and with incorrect interpretation of the data. For example, an intramural thickening of the loops of the intestine and the walls of the appendix can be observed not only in acute appendicitis, but also in Crohn's disease. In Crohn's disease, a hyperechoic submucous layer is visualized on echograms. A local thickening of the wall is observed in neoplasms involving the appendix. Detected by ultrasound, a small amount of free fluid in the abdominal cavity is also found in other diseases.

The most common complications in children include appendicular abscesses, infiltrates, peritonitis. The appendicular abscess was the result of destructive appendicitis, when local purulent peritonitis was delimited by fibrinous commissures. Another cause of appendicular abscess was suppuration of appendicular infiltrate (in 2.5% of children). According to our data, the appendicular abscess was mainly localized in the iliac fossa and less often in the retroperitoneal space retrocecal and in the small pelvis. The clinical picture of appendicular infiltrate develops by 3-5 days of the disease. In our observations, with loose infiltrate, a thickening of the wall of the cecum more than 3-3.2 mm was visualized sonographically, thickening of the wall of the ascending part of the colon, the contours of the walls were fuzzy, there was no peristalsis. The structure of the infiltrate is heterogeneous with hypoechoic fluid areas. With dosed compression, the sensor noted severe pain. The surrounding hyperechoic tissue and the intestinal area represented a motionless heterogeneous structure with blurry contours and not mobile during compression by the sensor. The appendicular abscess in the retroperitoneal space in our observations was the outcome of appendicular infiltrate. An ultrasound abscess was visualized as a hypoechoic mass (cavity) with a fuzzy blurred outline. Its walls were uneven, thickened. Hypoechoic heterogeneous suspension with gas bubbles was sometimes observed in the abscess cavity. The shape of the abscess was different: oval, irregular, star-shaped [17, 18]. The causes of diagnostic errors in the diagnosis of acute appendicitis can be objective and subjective. One of the objective reasons is the diversity of pathology. Complete ultrasound examination with an assessment of the state of the abdominal organs, and not just the iliac region, will, in our opinion, avoid diagnostic errors and improve the quality of diagnosis. To clarify the diagnosis in

complex cases, dynamic monitoring is required. We believe that the frequency of examination for suspected acute appendicitis is necessary after 6-7 hours [19, 20]. Our experience indicates that the conclusion of an ultrasound examination in acute appendicitis in most cases is the basis for surgery.

CONCLUSION

Thus, the study of the characteristics of the course of various clinical forms of acute appendicitis in children has made it possible to increase the efficiency of diagnosis and improve treatment results. In diagnosed with acute appendicitis in many cases, the results of ultrasound examinations determine the choice of anesthesia, as well as access during surgery. Having high information content, complex echography in many cases allows you to abandon vain laparoscopic examinations.

Ultrasonography is a promising and safe method for the diagnosis of acute appendicitis in children, which makes it possible to bring the effectiveness of complex diagnostics closer to 100% and which is of great importance in choosing treatment tactics.

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