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NON-INVASIVE ULTRASOUND EXAMINATION METHODS OF THE GASTROINTESTINAL TRACT

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Introduction: Currently, the diagnosis and monitoring of gastrointestinal tract (GIT) diseases is one of the urgent problems of modern medicine. Although endoscopic methods provide accurate information, they are invasive in nature, unpleasant for patients, and sometimes carry the risk of complications. For this reason, the importance of non-invasive examination methods is steadily increasing.

Ultrasound examination (USE), due to its safety, affordability, widespread availability, and real-time implementation, occupies an important place in medical practice. The capabilities of ultrasound diagnostics in detecting gastrointestinal tract pathologies are constantly expanding.

Ultrasound Examination Technique Of The Gastrointestinal Tract

Patient preparation. Proper patient preparation is of great importance for ultrasound examination of the gastrointestinal tract. Fasting for 8-12 hours before the examination is recommended. To reduce gas accumulation in the intestines, it is necessary to avoid gas-producing foods several days before the examination. In some cases, sorbents and antispasmodic medications are used.

Examination methodology. Ultrasound examination is usually performed using convex or linear transducers with frequencies ranging from 3.5-7.5 MHz. The patient can be examined in supine, lateral, or sitting positions. Scanning in various projections allows visualization of all sections of the GIT.

Ultrasound Characteristics Of Gastrointestinal Tract Anatomy

The healthy stomach wall appears as a multilayered structure on ultrasound examination. Wall thickness usually does not exceed 5 mm. Five layers are distinguished on ultrasound: mucosa, muscularis mucosae, submucosa, muscularis propria, and serosa. Each layer has its own characteristic echogenicity level.

Intestinal wall structure. The walls of the small and large intestines also have a layered structure. The healthy small intestinal wall is 2-3 mm thick, while the large intestinal wall is 3-4 mm thick. In pathological processes, these indicators may change significantly.

Ultrasound Diagnosis Of Stomach Diseases

Gastritis and gastric ulcer. In chronic gastritis, diffuse or local thickening of the stomach wall is observed. Layered structure may be disrupted. In gastric ulcer, local wall thickening, crater-shaped depression, and signs of perifocal inflammation are detected. Ultrasound examination helps assess ulcer depth and risk of complications.

Gastric tumors. Ultrasound diagnostics plays an important role in early detection of gastric tumors. Malignant tumors are characterized by sharp wall thickening, loss of layered structure, irregular contours, and low echogenicity. Benign tumors appear as well-defined formations with homogeneous structure.

Gastric stenosis. In pyloric stenosis, gastric dilation, wall thickening, and impaired peristalsis are observed. Ultrasound can assess the degree of stenosis and gastric evacuatory function.

Ultrasound Diagnosis Of Small Intestinal Pathologies

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Inflammatory diseases. In small intestinal inflammation, wall thickening, changes in echogenicity, and impaired peristalsis are noted. In acute enteritis, intestinal wall thickness may increase to 4-5 mm, with possible fluid accumulation in between. In chronic form, wall thickening is stable with signs of fibrosis.

Crohn's disease. In Crohn‘s disease, ultrasound examination allows detection of characteristic changes. Segmental intestinal wall thickening, preservation of layered structure, enlargement of mesenteric lymph nodes, and possible fistula formation may occur. In Doppler mode, increased blood flow in inflammatory foci is detected.

Intestinal obstruction. In mechanical obstruction, intestinal lumen dilation, fluid and gas accumulation, “keyboard” sign, and retrograde peristalsis are observed. Ultrasound examination helps identify the cause and degree of obstruction.

Ultrasound Diagnosis Of Large Intestinal Diseases

Ulcerative colitis. Ulcerative colitis is characterized by diffuse thickening of the large intestinal wall, loss of haustration, hyperechogenicity of the mucosa, and hypoechogenicity of the submucosal layer. In severe forms of the disease, ulceration and pseudopolyps may appear in the intestine.

Diverticulosis and diverticulitis. Diverticula are detected on ultrasound as cavity-like formations protruding outward from the intestinal wall. In diverticulitis (inflammation), surrounding fluid accumulation, wall thickening, and perifocal changes are observed.

Large intestinal tumors. Colorectal cancer on ultrasound manifests with local wall thickening, heterogeneous structure, disruption of layered architecture, and irregular contours. In advanced disease, involvement of adjacent organs and metastases may be detected.

Appendicitis. In acute appendicitis, the characteristic features include a diameter exceeding 6-7 mm in cross-section of the appendix, “target” sign in longitudinal section, wall thickening, and periappendiceal fluid accumulation. In Doppler mode, hypervascularization in inflammatory foci is observed.

Modern Ultrasound Technologies

Contrast-enhanced ultrasound. The use of modern contrast agents significantly increases the sensitivity of ultrasound diagnostics. This method is of great importance in determining the nature of tumor formations, blood supply, and degree of inflammation.

Elastography. Elastography allows assessment of tissue elasticity and stiffness. This method is used to differentiate malignant and benign tumors, detect fibrotic changes, and evaluate treatment effectiveness.

3D ultrasound. Three-dimensional ultrasound examination allows obtaining spatial images of anatomical structures. This method is useful for more accurate assessment of pathological changes volume and planning surgical interventions.

Doppler sonography. Using color Doppler sonography and power Doppler, it is possible to assess blood supply to GIT organs. Hypervascularization in inflammatory processes and appearance of pathological blood vessels in tumors are detected.

Advantages And Limitations Of Ultrasound Examination

Main advantages. The most important advantages of ultrasound diagnostics are: non-invasiveness and safety of the method, absence of radioactive radiation, relative affordability, widespread availability, and possibility of dynamic monitoring. Real-time examination allows assessment of the functional state of organs.

Limitations and difficulties. Ultrasound diagnostics has certain limitations. Gas accumulation in the intestines, obesity, scars after previous operations, and the importance of

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operator qualification are significant. Some pathological changes may not be clearly visible on ultrasound and require additional examination methods.

Comparison With Other Diagnostic Methods

When comparing ultrasound examination with endoscopy, radiological methods, and computed tomography, each method has its own advantages and disadvantages. Endoscopy provides direct visualization and biopsy capability but is invasive. Computed tomography has high accuracy but involves radiation exposure and is more expensive. Ultrasound is considered the optimal method for screening examination and dynamic monitoring.

Clinical Application

Ultrasound diagnostics is widely used in the initial stage of detecting gastrointestinal tract diseases. In screening programs, emergency situations, pregnant women, and children, this method is chosen first. Ultrasound also plays an important role in evaluating treatment effectiveness and monitoring disease progression.

Conclusion

Non-invasive ultrasound examination of the gastrointestinal tract is an important diagnostic method in modern gastroenterology. The advancement of technologies, use of high-frequency transducers, contrast agents, and additional methods (elastography, 3D examination) significantly expand the capabilities of ultrasound diagnostics. The method's safety, economic efficiency, and possibility of repeated examinations make it an ideal method for screening programs and dynamic monitoring. However, for accurate diagnosis, it is often necessary to combine ultrasound data with results of other diagnostic methods. In the future, the implementation of artificial intelligence technologies and development of new methods will serve to further improve the quality of ultrasound diagnostics.

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