The role of an ultrasound diagnosis in acute intestinal obstruction in malignant tumor

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Abstract
Background: Ultrasound has become increasingly important in the diagnosis of acute pathology of the abdominal cavity as an accessible, non-radiation-related method. In the present study, we evaluated the effectiveness of ultrasound diagnostics for cases of tumor with intestinal obstruction.

Methods: An ultrasound examination was performed in 41 patients (28 men and 13 women) between 26 and 78 years of age with intestinal obstruction who were treated at the surgical department of the hospital of Tashkent Medical Academy from 2014 to 2018. An ultrasound examination was performed without prior preparation using the ultrasonic devices Landwind Mirror 2 and SonoScape. Patients were examined in the supine position for their epi-, meso- and hypogastric areas and from the side of the abdomen for the frontal and oblique sections with compressing these sensor to the abdominal wall.

Results: All patients had chronic intestinal obstruction. The cause of the mechanical obstruction was a colonic tumor in 34 (83%) cases, tumor of the small intestine in 1 (2.5%) case and bowel torsion in 6 (14.5%) cases. The duration from the onset of the first clinical symptoms to the primary ultrasound examination ranged from 2 h to approximately 3 days. Ultrasound for evaluating the dynamics of acute intestinal obstruction allow for an accurate assessment of the state of the intestine, regardless of when the disease first manifested.

Conclusions: Repeated ultrasound studies of patients with colonic obstruction are more informative because the swelling of the colon was observed only in combination with evaluation of intestinal wall changes which is specific for the tumor.

Keywords: Ultrasound, intestinal obstruction

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The evaluation of the ultrasound findings

An ultrasound examination was performed without prior preparation using the ultrasonic devices Mirror 2 (Shenzhen Landwind Medical Co., Ltd, Shenzhen, P.R.China) and SonoScape S50 (SonoScape Medical Corp. Shenzhen, P.R.China). Patients were examined in the supine position for their epi-, meso- and hypogastric areas and from the side of the abdomen for the frontal and oblique sections with compressing these sensor to the abdominal wall. The width of the intestinal lumen, the condition of the wall and folds of the structure of the inner shell, the nature of peristalsis and the movement of contents in the loop lumen were determined by the number of anatomical areas in which the intestinal loops were visualized as well as based on the movements of the loops relative to each other and the anterior abdominal wall. To systematize the ultrasound picture of the intestinal state depending on the duration of the disease, 3 periods of observation were denoted: 2 to 6 h, 6 to 24 h, and ≥24 h from the appearance of the first clinical symptoms of the disease. Most patients (n = 22) were evaluated in the early period (2 to 6 h), followed by 6 to 24 h (n = 13) and ≥24 h (n = 6).

Ethics

The study was approved by the Institutional Review Board of each hospital.

RESULTS

Demographic and clinical characteristics

All patients had chronic intestinal obstruction. An ultrasound examination was performed in 41 patients (28 men and 13 women) between 26 and 78 years of age. The cause of the mechanical obstruction was a colonic tumor in 34 (83%) cases, tumor of the small intestine in 1 (2.5%) case and bowel torsion in 6 (14.5%) cases. The duration from the onset of the first clinical symptoms to the primary ultrasound examination ranged from 2 h to approximately 3 days.

Ultrasound examination findings

The first stage of the study of the intestine in cases of suspected intestinal obstruction was the assessment of the lumen and the structure of the intestinal wall loops. Among 41 patients, the expansion of the lumen with an intestinal body length of 22–34 mm (compared with a normal value not exceeding 20 mm) was detected in 14 patients. In four cases, it was not possible to measure the width of the intestinal lumen due to the swelling of the loops. A three-layer-structure round gut wall with clear differentiation (surface, muscular and mucous layers) was detected in nine patients. In these same patients, the Kerckring’s folds were not visualized. A similar ultrasound picture revealed no wall edema in these observations. Seven patients had soreness at intestinal loops visualized by ultrasonographic examination - hoisted in the form of a conglomerate and not shifted relative to each other. In the walls of loops of intestines that were in the conglomerate in six patients. In 4 cases, peristalsis showed a medium amplitude (30%–50%) and medium frequency (3–4 min). The movement of the intestinal contents in eight people was the type of Brownian motion, and in two people, there was place of translational movement of the chyme. Pendulum periods were noted in 7 observations on the background of the Brownian motion of the contents different movements due to antiperistalsis. Changes in peristalsis and movement of content in all patients are better visualized at the portion of stronger pain.

The localization of the altered loops differed among patients. In seven cases, at the level of the terminal ileum, the expanded loops of the small intestine filled almost all parts of the abdominal cavity. Six patients with pathologically changed loops had loops located in the mesogastric region. In three cases, the loops of the small intestine occupied only the left half of the abdominal cavity; the lumen of the duodenum and the stomach, the presence of gas and excess liquid was determined. Nine of the 13 patients with a disease period of 6 to 24 h who were examined showed dilation of the intestinal loops from 35 to 50 mm. In 3 patients, the degree of dilation was less pronounced and similar to that of the 2 to 6 h group: from 22 to 34 mm. In seven patients, the immobile intestinal loops were visualized in the abdominal cavity, the wall of which in six cases was locally hypoechoic, without differentiation of the layers. The structure of the intestinal contents in four people was heterogeneous, showing mostly reduced hydrochloric echogenicity (which is typical for prevailing liquid over gas), although hyperechoic inclusions were visualized in some areas in two patients a swelling predominated over fluid accumulation.

Regarding the background of the hypoechoic content in six patients, thickened Kerckring’s folds were clearly defined. In five cases, peristalsis was evaluated as medium, 3 - high amplitude, 3 - high frequent, 1 - middle frequent and 1 - with antiperistalsis. The pendulum-like movement of the contents was observed in 10 people, and in 2 - the chyme motion was in the type of Brownian movement. In the observation period in 4 patients was determined on the presence of fluid in the interline space, in 3 a fluid was found in the lateral channels of the abdominal cavity.

A re-examination was performed in five patients. Four showed the increasing expansion of light loops of the small intestine to 45–50 mm. The structure of the wall in three cases retained a layered structure, while the other two showed hypoechoic endless - structural zones. The intra-intestinal contents in all five patients became more hypoechoic, and thickened folds of Kerckring were
noted in four people. High-amplitude peristalsis persisted in four patients, while anti-peristalsis appeared in one. Moving the contents of all patients had a differences in pendulum-like moving. In three cases, visualization was possible. Conglomerated unshiftable intestinal loops and small amount of liquid around it were observed in two cases. In the cases of more delayed disease (≥24 h from the onset of symptoms), we examined 6 patients. In this group, the small intestinal loops were dilated to 47–50 mm, and in 1 patient, the diameter of the small intestine met the normal criteria, the intestinal wall is represented by a thickened hypoechoic structure without differentiation of layers, and in 1 patient the structure of walls is not broken. The structure of the intestinal contents in five patients is represented by the fluid with heterogeneous echogenicity, on the background of which thickened Kerckring’s folds of the mucous membrane was clearly defined. In one case in the lumen of the intestine on the background of liquid a large amount of gas was being altered. During our study of the motions of the small intestine over 30 min in four patients, peristaltic waves and moving contents was not determined. In one patient with a tumor of the cecum, low-amplitude and low-frequency peristalsis without moving of the contents was detected. In the lateral channels of the abdominal cavity in 4 patients revealed a small amount of fluid. On an examination of the colon in two people with a sigmoid tumor, widening of the ascending and transverse colon up to 60–65 mm with a distinct predominance of gas in the lumen was visualized. The wall of the colon in these patients have a normal layered structure with 2–3 mm of thickness, peristalsis was high-amplitude and low frequent. The examination of 3–5 cm of the sigmoid colon revealed the narrowing lumen of the loop of the intestine up to 2–8 mm, wall thickening up to 8 mm, reduction of echogenicity and absence of its layered structure.

**Discussion**

All patients in the dynamics on ultrasound diagnostics got more determined expansion of the lumen of the loops of the thin (up to 35 mm) and thick (up to 50 mm) intestines. However, the normal thickness and structure of the wall was preserved in eight patients, three of whom showed indistinct differentiation of the wall layers without changes to its thickness. The intestinal contents in five patients showed high echogenicity due to the predominance of gas in the lumen of the intestine, while six showed low echogenicity due to the predominance of fluid. Significantly attenuated frequencies (1–2 contractions per minute) and amplitudes (10–20%) occurred in 3 patients, and peristalsis of the intestinal wall was absent in 8. Content movement was not observed in any of the patients. Regardless of the location of the main disease, wide intestinal loops occupied almost the entire abdominal cavity in all patients. When the sensor was compressed in 11 patients, the loops shifted to each other and the anterior abdominal wall. During this observation period, fluid was detected in the abdominal cavity in four patients.

Among cases of a longer duration (≥24 h) from the appearance of clinical signs of disease, we observed 6 patients who had dilatation of the inner diameter of the loops ranging 35 to 60mm and dilatation of the intestinal lumen ranging 27 to 50 mm.

The intestinal wall in four of these patients showed a thickened hypoechoic structure without differentiation of layers, and in one patient, changes were visualized in separate areas of the small and large intestine along with undistressed walls on separate fragments. No structural changes in the wall were detected in one patient. Internal anechoic almost homogeneous contents of intestinal loops were observed in all seven patients, and thickened Kerckring’s folds were visualized on a background of fluid in the lumen of the intestine. Peristalsis and movement of the contents were not noted in any of the patients. A liquid fluid was present in the interloop apace, the pelvis, and the lateral canal in 5 patients, and was so only in the small pelvis in one patients.

**Conclusion**

Ultrasound for evaluating the dynamics of acute intestinal obstruction allow for an accurate assessment of the state of the intestine, regardless of when the disease first manifested. Repeated ultrasound studies of patients with colonic obstruction are more informative because the swelling of the colon was observed only in combination with evaluation of intestinal wall changes which is specific for the tumor.

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**CONFLICT OF INTEREST STATEMENT:**

None declared.

**REFERENCES**

1) Legostaeva TB., Kirillova, Nfu. Possibilities of ultrasonography in the differential diagnosis of strangulation and obturation forms of commissural small intestine ileus. Vestn Rentgenol Radiol (2001) 1 37-42.

2) Min’ko BA, Kushnerov AI, Pruchanskiy VS, Alieva LB. Ultrasound diagnosis of acute cancer-related colorectal obstruction. Vopr Onkolog (2003) 49(6) 755-758.

3) Portnoy LM, Legostaeva TB., Kirillova Nfu. A role and a place of ultrasound diagnosis of acute ileus. Vestn Rentgenol Radiol (2003) 3 4-15.

4) Portnoy L, Legostaeva T, KirillovaN. Ultrasound study in the diag-
5) Araki T, Okita Y, Uchino M, Ikeuchi H, Sasuki I, Funayama Y, Fukushima K, Futami K, Maeda K, Iiai T, Itabashi M, Hase K, Motoya S, Kitano A, Mizushima T, Maeda K, Kobayashi M, Mohri Y, Kusunoki M. Risk factors for patients with ulcerative colitis: a multicenter prospective study. Surg Today (2014) 44 1072-1078.

6) Dux M, Richter GM, Roeren T. Gastrointestinal imaging with hydrosonography and hydro-CT. Rofo (1996) 164(5) 359-367.

7) Katoh T, Shigemori T, Fukaya R, Suzuki H. Cecal volvulus report of a case and review of Japanese literature. World J. Gastroenterol (2009) 15(20) 2547-2549.

8) Schmutz GR, Benko A, Fournier L, Peron JM, Morel E, Chiche L. Small bowel obstruction: role and contribution of sonography. Eur Radiol (1997) 7(7) 1054-1058.