https://doi.org/10.33878/2073-7556-2021-20-4-34-41

Computer tomography in diagnostics and treatment of inflammatory complications of diverticular disease of the colon

Oleg Yu. Karpukhin[1,2] Alsu F. Yusupova[1,2], Yulia S. Pankratova[1], Malika I. Cherkashina[2], Albina A. Akhmadullina[1]

[1]Kazan State Medical University (Butlerov Street, 49, Kazan, 420012, Russia)
[2]Republican Clinical Hospital (Orenburg tract, 138, 420064, Kazan, Russia)

ABSTRACT *AIM: to evaluate the role of computed tomography (CT) in the treatment and diagnostic algorithm in patients with complicated diverticular disease (CDD).*

PATIENTS AND METHODS: during the period from 2014 to 2020, 165 hospitalized patients with complications of CDD included in the study. Fifteen (9.1%) patients were hospitalized for elective indications and 150 (90.9%) as emergencies. The indications for hospitalization were inflammatory complications of CDD. Computed tomography with intravenous contrast was performed in 89 (53.9%) patients. The study was performed on a 64-slice CT "Philips Brilliance 64" with intravenous bolus injection of a low-osmolar iodine-containing contrast agent. The absence of the CT in the remaining patients is due to the presence of classical symptoms of acute diverticulitis with a previously verified diagnosis of CDD, the presence of an informative transabdominal ultrasound, as well as the refusal of patients from CT.

RESULTS: the CT allowed to verify the presence of diverticula in the patients, to reveal the distinctive CT signs and pathognomonic symptoms of inflammatory complications of CDD, as well as to establish the severity of the complications that occurred. The specific signs of the destruction of the diverticulum and the complications developed were abdominal mass, abscess, peritonitis, and fistula. Besides the diagnostic value, CT scan permitted to choose the treatment approach and to clarify indications for surgery. Besides that, some CDD complications revealed by CT were considered as a predictor of ineffectiveness of conservative treatment, which requires surgery.

CONCLUSION: CT is a valuable diagnostic method for CDD which allows to determine timely the clinical form of inflammatory complication, to find out indications for surgery and to predict high risk of recurrence.

KEYWORDS: *complicated forms of colonic diverticular disease, CT-diagnostics, predictors of recurrence*

CONFLICT OF INTEREST: *The authors declare no conflict of interest*

THE STUDY HAD NO SOURCE OF FUNDING.

FOR CITATION: Karpukhin O.Yu., Yusupova A.F., Pankratova Yu.S., Cherkashina M.I., Akhmadullina A.A. Computer tomography in diagnostics and treatment of inflammatory complications of diverticular disease of the colon. *Koloproktologia.* 2021;20(4):34–41. (in Russ.). https://doi.org/10.33878/2073-7556-2021-20-4-34-41

ADDRESS FOR CORRESPONDENCE: *Karpukhin Oleg Yurevich, Kazan State Medical University, Butlerov Street, 49, Kazan, 420012, Russia; e-mail: oleg_karpukhin@mail.ru*

Received — 31.05.2021 *Revised — 02.08.2021* *Accepted for publication — 30.11.2021*

INTRODUCTION

Diverticular colon disease is one of the most common diseases in Western civilization.

It is distinguished by a variety of manifestations from the asymptomatic to complicated forms requiring urgent surgery. Thus, up to 20% of patients with diverticular disease suffer from acute diverticulitis, which, as a result of inflammatory destruction of the diverticulum, can be complicated by peritonitis, abscess or fistula [1].

Complicated diverticular disease (CDD) becomes an often cause of hospitalization of patients for emergency indications in urgent surgery or coloproctology units, where complex, often multistage surgical approach is carried out.

Thus, the widespread prevalence of the disease, severe complications requiring urgent surgery with long-term postoperative rehabilitation of

patients, determines the need for early diagnosis and timely treatment.

Currently, computed tomography (CT) of the abdomen and pelvis with intravenous contrast is considered abroad as an effective method of visual assessment of diverticular inflammation, which allows not only to verify the presence of acute diverticulitis, but also to determine the clinical form of an inflammatory complication, to make differential diagnosis, and in the presence of complications such as perforation and abscess, to choose the treatment [2–4]. At the same time, the sensitivity of CT in diverticular inflammation varies from 79% to 99% [3,5].

In the Russian literature, the issue of CT in the presence of a clinical picture of CDD remains debatable [6]. The issue has not been resolved as to whether it is advisable to perform CT of the abdomen to clarify the diagnosis during the initial treatment. Predictors have been reported that are highly likely to indicate acute diverticulitis, such as pain in the left iliac region, which increases with movement, the patient's age is over 50 years old, episodes of acute diverticulitis in the history, pain during palpation in the lower abdomen, elevated levels of C-reactive protein (above 50 mg/l), absence of vomiting [7]. The authors of the study state that if these signs are present in the clinical picture, additional visualization can be excluded. In other studies, on the contrary, it is claimed that the accuracy of the diagnosis of acute diverticulitis based on clinical evaluation alone is low, with sensitivity of 64% and 68% [8,9]. Therefore, most authors prefer CT when diagnosing acute inflammatory CDD [5, 10, 11], which is due to the possibility of the method not only to detect diverticula, but also to determine with a high degree of reliability the form of inflammatory CDD complications, and to differentiate diverticular disease with other intestinal diseases [12].

AIM

To evaluate the role of computed tomography in the treatment and diagnostic algorithm for CDD.

PATIENTS AND METHODS

In 2014–2020, 165 patients with CDD were on inpatient treatment in the coloproctology unit of the RCH of the Health Ministry of the Republic of Tatarstan. At the same time, 7 (4.2%) of them were hospitalized for this reason repeatedly. There were 55 males (33.3%) and 110 females (66.7%). The age was 26–91 (60.8 ± 11.1) years.

Fifteen (9.1%) patients were hospitalized as elective, while 150 (90.9%) — for emergency indications. The reason for hospitalization of the patients in the surgery unit was: acute diverticulitis — 78 (47.3%), including 58 — with primary attack, 20 — with recurrent diverticulitis; abdominal mass — 31 (18.8%); colonic bleeding — 28 (17%); abdominal or mesocolon abscess — 15 (9.1%); perforation of the diverticulum, complicated by peritonitis — 6 (3.6%); colovesical fistula — 4 (2.4%); stricture of the sigmoid colon, complicated by chronic 2 (1.2%) or acute 1 (0.6%) intestinal obstruction. One patient had recurrent colonic bleeding (inpatient treatment was carried out 4 times).

CT with intravenous contrast was performed in 89 (53.9%) patients during primary hospitalization in the coloproctology unit.

In the remaining group of the patients, CT was not carried out, which was due to the presence of classical symptoms of diverticulitis with a previously verified diagnosis of CDD, as well as the presence of an informative, non-doubtful conclusion of transabdominal ultrasound. Two patients categorically refused CT due to the fear of radiation exposure. In the group of the patients with colonic bleeding, colonoscopy was the primary diagnostic method.

The study was performed on a 64-slice computer tomograph 'Philips Brilliance 64' using intravenous nonionic low-osmolar iodine-containing contrast agent (yopromide, yoversol, yogexol).

In case of suspicion of an acute surgical situation that developed as a result of CDD, CT was performed directly upon admission of the patient to the clinic. Thirty minutes before the study, the patient drank 500 ml of water with a water-soluble radiopaque drug.

In elective patients CT was performed on an empty stomach, without bowel cleansing. On the eve of the test, the patient drank 250 ml of water with a water-soluble iodine-containing contrast agent and another 250 ml 30 minutes before the study. If an internal fistula of diverticular origin was suspected, 150 ml of a weak solution of a water-soluble radiopaque enema was used.

RESULTS AND DISCUSSION

The distribution by groups of the patients, in whom CT was used in the diagnosis, taking into account the form of inflammatory complications and the treatment performed, is shown in Table 1. In one patient with chronic recurrent diverticulitis, CT did not reveal signs of diverticula; so the diagnosis was verified by barium enema and intraoperatively.

CT in the patients with various variants of CDD allowed to identify characteristic CT signs of acute diverticulitis, diverticular destruction, infiltration, abscess, stricture and fistula of diverticular origin.

In acute diverticulitis, computer tomograms along the circumference of the intestinal wall featured various-sized baggy protrusions with fuzzy contours, as well as thickening of the walls of the affected segment of the colon with narrowing of its lumen (Fig. 1). Thickening of the colon walls, reaching 4 mm or more, was detected in 82 (92.1%) patients, while the length of the inflammatory segment of the colon varied from 20 to 56 mm.

According to Kandagatla, P.G., Stefanou, A.G. (2018), the length of the inflammatory lesion of the intestinal wall of over 5 cm in CDD increases the likelihood of the disease recurrence [13].

Signs of the spread of inflammation beyond the diverticulum with the abdominal mass on CT are inflammatory changes in pericolic fat, manifested by unevenness, heaviness of its structure due to many layers of fluid against the background of edema of adipose tissue as a result of inflammatory changes in diverticula, the so-called 'dirty fat' [2,5] (Fig. 2).

A formidable CDD is the perforation of the diverticulum with the abscess or peritonitis (depending on the site of the diverticulum). Signs of destruction of the diverticulum according to CT data were infiltration of pericolic fat with the inclusion of gas bubbles or accumulation of contrast agent outside the intestinal lumen. With the destruction of the diverticulum located along the mesenteric side of the intestine, the entry of intestinal microflora and gas more often occurs in the mesenteric fat. At the same time, the clinical manifestations of the resulting complication may be devoid of the classic signs of peritonitis. On CT scan, swelling of the root of the mesentery of the colon can be observed, as well as the so-called 'comma' symptom [2, 14] — thickening and accumulation of fluid in the fascia of the left lateral canal or the retrocolic fascia (Fig. 3).

During the perforation of the diverticulum with an abscess, a cavity with the level of liquid and gas in the mesentery or pericolic tissue, or in various parts of the peritoneal cavity, was visualized on the CT scan.

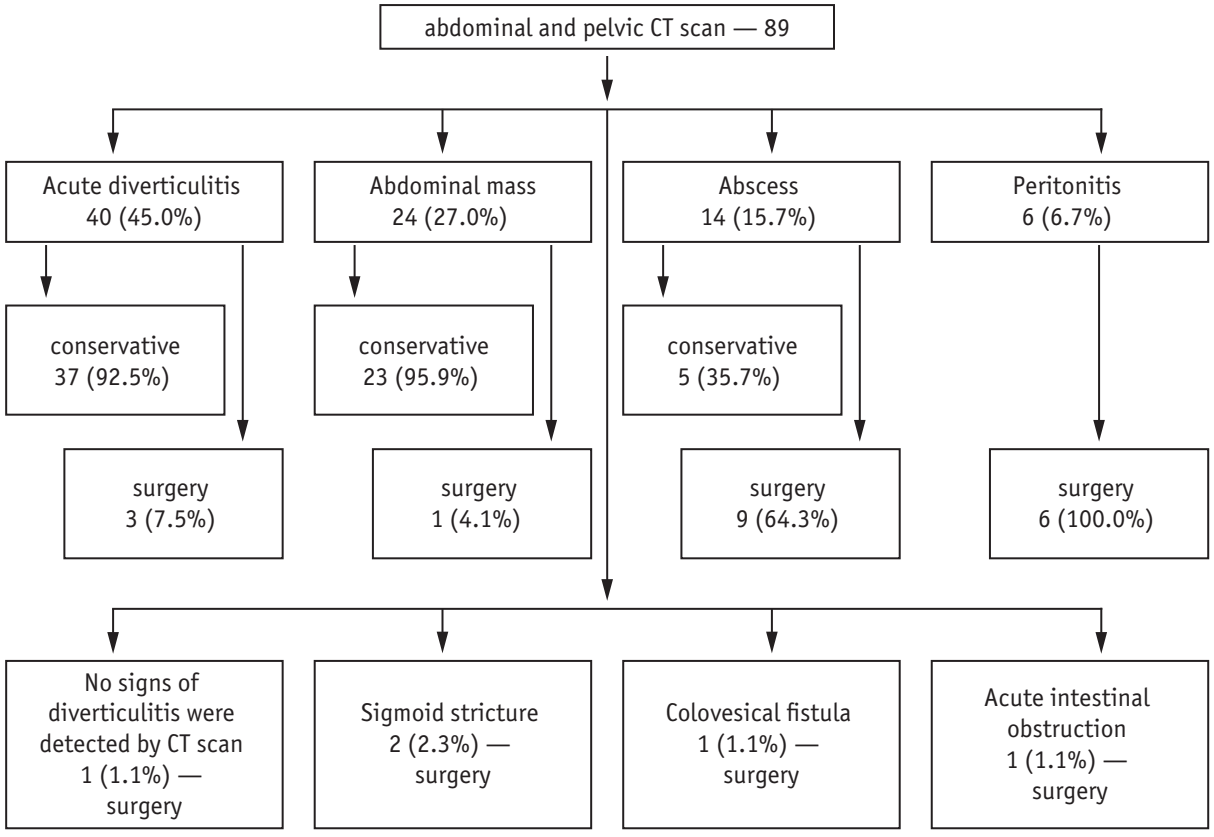
We identified abscesses in 14 patients. At the same time, in 5 (35.7%) of them, the size of the abscess was no more than 30 mm, and in 9 (64.3%) patients, the size of the liquid collection exceeded this parameter, reaching 121 × 95 × 60 mm in one case (Fig. 4–5).

With diverticular peritonitis, CT scans showed accumulations of free fluid near the affected segment of the colon, in the pelvis, in various parts of the peritoneal cavity, as well as inflammatory infiltration of pericolic fat with gas bubbles, gas accumulation in the abdomen under the anterior abdominal wall (on axial view).

In the presence of a colovesical fistula, direct (gas bubbles in the lumen of the bladder) and indirect (thickening, deformation of the bladder wall) signs of pathological communication between organs were detected (Fig. 6).

Also, we studied the results of an alternative method in the diagnosis of acute CDD complications — transabdominal sonography. We used transabdominal ultrasound as a first-line diagnostic method in all the patients with suspected CDD. The undoubted advantage of the method is its high availability, safety and low

Table 1. *CDD and approach in the group of patients with abdominal and pelvic CT scan*



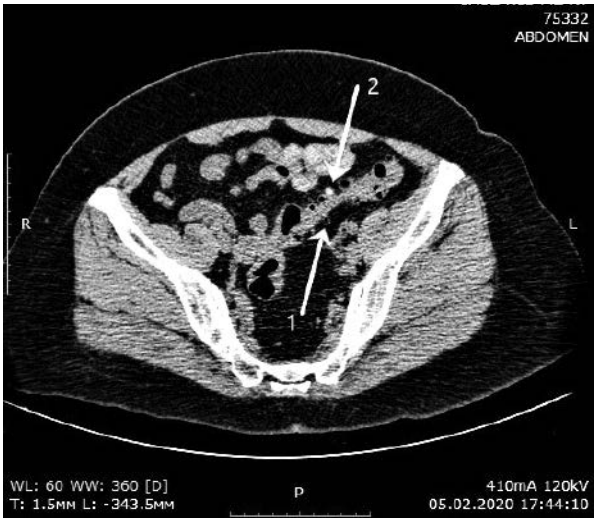


Figure 1. *CT of patient J, 53 years old. Axial section. Diverticular disease of the left colon complicated by diverticulitis. Multiple diverticula with thickened walls filled with air (arrow 1) and coprolites (arrow 2).*

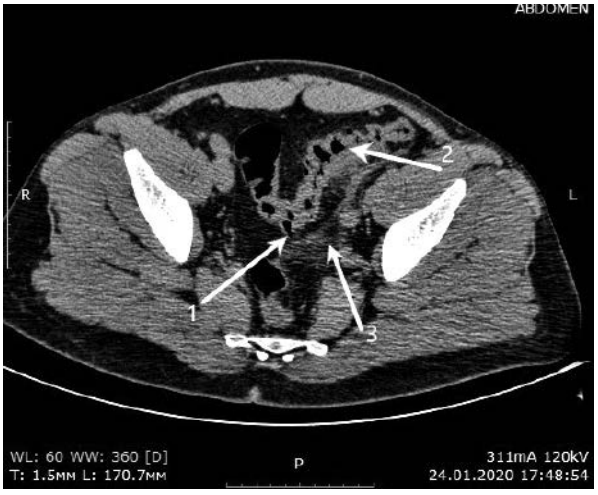


Figure 2. *CT of patient K., 42 years old. Diverticular disease of the sigmoid colon complicated by diverticulitis. Diverticulum of the sigmoid colon (arrow 1), significant thickening of the walls of the sigmoid colon, narrowing of its lumen (arrow 2), infiltration of pericolic fat (arrow 3).*

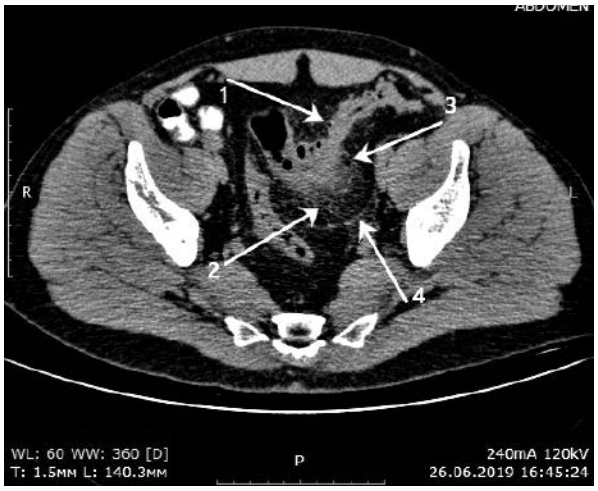


Figure 3. *CT of patient B., 64 years old. Diverticular disease of the sigmoid colon complicated by diverticulitis. Multiple diverticula of the sigmoid colon (arrow 1). Stranding of paracolic fat (arrow 2). Gas outside the intestinal lumen (arrow 3). Thickening of the mesenteric root of the sigmoid colon and f. retrocolica (arrow 4).*

Figure 4. *CT of patient A., 62 years old. Diverticular disease of the sigmoid colon, pelvic abscess. Diverticulum of the sigmoid colon (arrow 1). Large abscess of the pelvis 121×95×60 mm (arrow 2).*

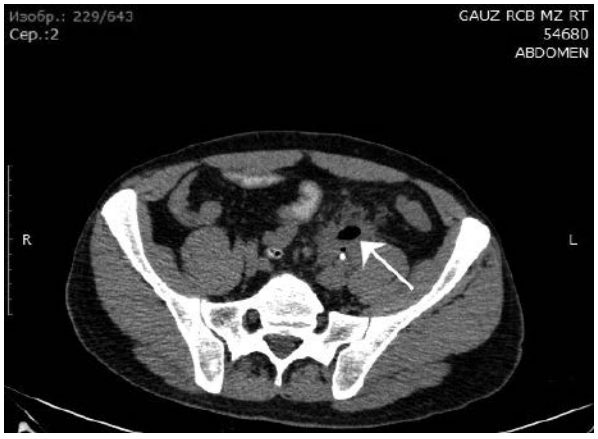


Figure 5. *CT of patient X., 41 years old. Diverticular disease of the sigmoid colon complicated by pericolic abscess with horizontal fluid level (arrow).*

cost. In addition to imaging the diverticula themselves, we noted sonographic signs of diverticulitis: thickening of the colon wall and infiltrative changes in . Only in 2 out of 4 cases, ultrasound examination revealed signs of perforation of the diverticulum — the presence of air bubbles in the thickness of the infiltrated mesentery of the colon. The comparison of these methods of imaging in the diagnosis of CDD is of considerable clinical interest. However, it requires a more detailed analysis and deserves a special study.

The treatment of the patients with CDD was carried out in accordance with the national clinical guidelines [15]. The conservative treatment based on a combination of mesalazine and rifaximin was started in all the patients with acute diverticulitis, acute abdominal mass and pericolic abscess of small size (⩽ 3 cm) detected on CT scan. The conservative treatment was effective in 65 (98.4%) patients of this group.

Twenty-four (26.9%) patients were operated on. Indications for emergency surgery were perforated diverticulitis complicated by abscess — 9 (37.5%), peritonitis — 6 (25%), acute intestinal obstruction — 1 (4.2%). Indications for elective surgery included: often recurrent attacks — 4 (16.6%), failure of conservative treatment — 1 (4.2%), colon stricture with chronic obstruction — 2 (8.3%), colovesical fistula — 1 (4.2%).

Minimally invasive procedures — abscess drainage under ultrasound navigation were performed in 4 (16.7%) patients. Laparotomy

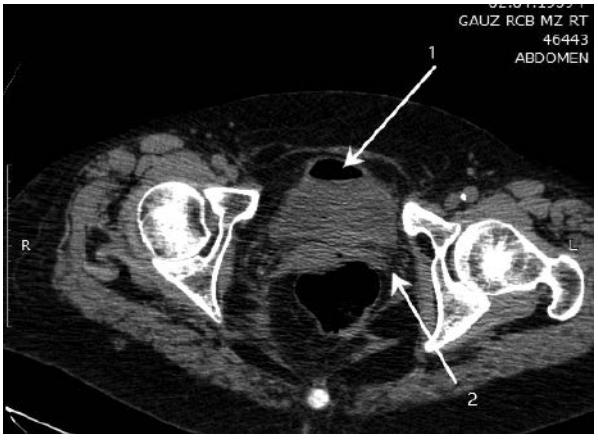


Figure 6. *CT of patient B. 58 years old. Diverticular disease complicated by colo-vesical fistula (arrow 1). Infiltration of the pericolic fat (arrow 2).*

was used in the remaining 20 (83.3%) patients with CDD. At the same time, sigmoid resection was performed in 14 (58.3%), left hemicolectomy — in 3 (12.5%) patients. In 2 (8.3%) patients with perforated diverticulitis complicated by the Douglas space abscess, a combined surgery was performed: resection of the sigmoid in combination with intraperitoneal anterior rectal resection due to the involvement of its wall in the abscess capsule. In 1 (4.2%) case, a right hemicolectomy was performed in a patient with inflammation of the diverticulum of the cecum with pericolic mass. In 10 (50%) cases, the resection was followed by colorectal anastomosis performed using an invagination technique in 7 patients, or using the traditional hand-sewn double-row anatomosis in 3 patients. Ten (41.6%) patients were operated on in two stages, followed by stoma takedown. Reconstructive procedures were performed 3–4 months after the relief of the inflammatory process with bowel hand-sewn double-row anastomosis in 6 (60.0%) patients, as well as by the invagination method in 4 (40.0%).

No postoperative mortality occurred. Postoperative complications developed in 4 (16.7%) patients: intraperitoneal hematoma (1), wound seroma (1), cubital vein phlebitis (1), acute jejunal ulcer (1). In the latter case, relaparotomy was required.

In 5 (21.3%) patients with abdominal mass, a relapse of the disease occurred during the year, in connection with which 3 patients were hospitalized again; and the conservative treatment was repeated. In the 2 remaining cases, due to the pericolic abscesses with signs of local peritonitis, the Hartmann's procedure was performed for urgent indications. It should be noted that at the initial admission of these patients, according to the CT data, signs of destruction (microperforation) of the diverticulum were detected. On CT scan, the same signs were noted in 2 (8.3%) patients, who were re-admitted and effectively treated conservatively.

However, one of them was hospitalized for the third time after 3 months due to a recurrent diverticulitis, complicated by perforation of the diverticulum and generalized peritonitis, which required emergency surgery. These cases confirm the opinion that the destruction of the diverticulum can be considered as a predictor of the failure of conservative treatment [4].

The effective drainage of the abscess under ultrasound navigation is also not an argument in favor of refusing surgery during the stabilization of the patient's condition, which is confirmed by the recurrence of this complication. Of the 4 patients, one was hospitalized again; the abscess was re-drained by ultrasound navigation; but the patient categorically refused the elective surgery. In another case, the patient was operated on after 2 months due to perforation of the diverticulum and the peritonitis. Sigmoid resection was performed; descendostomy was applied, followed by stoma takedown later. Follow-up of the 2 remaining patients allows to state the transition of the inflammatory process into a chronic one, with the preservation of complaints of abdominal pain syndrome, subfebrile fever, as well as an increased level of laboratory markers of inflammation.

CONCLUSION

Computed tomography is an effective diagnostic method for the CCD, which allows identification of a clinical form of an inflammatory complication, determining indications for surgery and predicting the likelihood of recurrence.

AUTHORS CONTRIBUTTON:

Concept and design of the study: *Oleg Yu. Karpukhin, Alsu F. Yusupova*

Collection and processing of the material: *Yulia S. Pankratova, Malika I. Cherkashina, Albina A. Akhmadullina*

Statistical processing: *Yulia S. Pankratova*

Writing of the text: *Oleg Yu. Karpukhin, Yulia S. Pankratova, Malika I. Cherkashina*

Editing: *Oleg Yu. Karpukhin, Alsu F. Yusupova*

INFORMATION ABOUT THE AUTHORS

Karpukhin, Oleg Y. — MD, Professor of Department of Surgical Diseases of Kazan State Medical

University of Health Ministry of Russia, Chief freelance Coloproctologist of Health Ministry of Republic of Tatarstan;
Yusupova, Alsu Faritovna — Candidate of Medical Sciences, Associate Professor of Department of Oncology, Radiation Diagnostics and Radiation Therapy of Kazan State Medical University of Health Ministry of Russia;
Pankratova, Yulia Sergeevna — postgraduate student of Department of Surgical Diseases of Kazan State Medical University of Health Ministry of Russia;
Cherkashina, Malika Ildarovna — doctor of Radiation Computed Tomography Unit of Republican Clinical Hospital of Health Ministry of Republic of Tatarstan;
Akhmadullina, Albina Ayratovna — student of Pediatric Department of Kazan State Medical University of Health Ministry of Russia.

INFORMATION ABOUT THE AUTORS (ORCID)
Oleg Yu. Karpukhin — 0000-0002-7479-4945
Alsu F. Yusupova — 0000-0003-2852-3471
Yulia S. Pankratova — 0000-0001-7498-2412
Malika I. Cherkashina — 0000-0002-7871-042X
Albina A. Akhmadullina — 0000-0002-7665-1534

REFERENCES

1. Timerbulatov M.V., Kulyapin A.V., Lopatin D.V. et al. Diagnostic tactics in the management of patients with diverticular disease complicated by perforated diverticulitis in 15 years. *Koloproktologia*. 2018;2:85–88. (In Russ.). DOI: 10.33878/2073-7556-2018-0-2-85-88.

2. Minordi LM, Larosa L, Berte G, et al. CT of the acute colonic diverticulitis: a pictorial essay. *Diagnostic and interventional radiology*. 2020;26(6):546–551. DOI: 10.5152/dir.2020.19645.

3. Sartelli M, Moore FA, Ansaloni L, et al. A proposal for a CT driven classification of left colon acute diverticulitis. *World journal of emergency surgery*. 2015; 10, 3. DOI: 10.1186/1749-7922-10-3.

4. Poletti PA, Platon A, Rutschmann O, et al. Acute left colonic diverticulitis: can CT findings be used to predict recurrence? *American Journal of Roentgenology*. 2004;182(5):1159–65. DOI: 10.2214/ajr.182.5.1821159. PMID: 1510011.

5. Destigter KK, & Keating DP. Imaging update: acute colonic diverticulitis. *Clinics in colon and rectal surgery*. 2009;22(3):147–155. DOI: 10.1055/s-0029-1236158.

6. Korneva E.P., Rostovtsev M.V., Nudnov N.V. et al. Possibilities of CT in the diagnosis of complications of intestinal diverticulosis (clinical observation). *Medical Visualization*. 2019;3:54–65. (In Russ.). DOI: 10.24835/1607-0763-2019-3-54-65.

7. Andeweg CS, Knobben L, Hendriks JC, et al. How to diagnose acute left-sided colonic diverticulitis: proposal for a clinical scoring system. *Annals of surgery*. 2011;253(5):940–946. DOI: 10.1097/SLA.0b013e3182113614.

8. Karidis NP, Dimitroulis D, Kouraklis G. The role of abdominal imaging in cases with a high probability of acute left-sided colonic diverticulitis based on a clinical scoring system. *Annals of surgery*.2013;258(2):14. DOI: 10.1097/SLA.0b013e31829c7a9d.

9. Toorenvliet BR, Bakker RFR., Breslau PJ, et al. Colonic diverticulitis: a prospective analysis of diagnostic accuracy and clinical decision-making. *Colorectal Disease*. 2010;12(3):179–186. DOI: 10.1111/j.1463-1318.2009.01778.x

10. Kaiser AM, Jiang JK, Lake JP, et al. The management of complicated diverticulitis and the role of computed tomography. *American Journal of Gastroenterology*. 2005;100(4):910–917. DOI: 10.1111/j.1572-0241.2005.41154.x

11. Baker M.E. Imaging and interventional techniques in acute left sided diverticulitis. *Journal of Gastrointestinal Surgery*. 2008;12(8):1314–1317. DOI: 10.1007/s11605-008-0490-2

12. Belov D.M., Zarodnyuk I.V., Mikhalchenko V.A.etal. Computed tomography diagnostic of inflammatory complications of colon diverticulitis (review). *Koloproktologia*. 2016;4:60–68. (In Russ.).

13. Kandagatla PG, Stefanou AJ. Current Status of the Radiologic Assessment of Diverticular Disease. *Clinics in colon and rectal surgery*. 2018;31(4):217–220. DOI: 10.1055/s-0037-1607466

14. Pereira JM, Sirlin CB, Pinto PS, et al. Disproportionate fat stranding: a helpful CT sign in patients with acute abdominal pain. *Radiographics*. 2004;24(3):703–15. DOI: 10.1148/rg.243035084.

15. Ardatskaya M.D., Achkasov S.I., Veselov V.V. et al. Clinical guidelines. Diverticular disease. *Koloproktologia*. 2021;20(3):10–27. (in Russ.). DOI: 10.33878/2073-7556-2021-20-3-10-27