Case Report

https://doi.org/10.23934/2223-9022-2022-11-3-516-524

Complex Application of Minimally Invasive Methods for the Treatment of Complicated Acute Severe Pancreatitis

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ABSTRACT Percutaneous interventions for the purpose of sanation of cavities of pancreatogenic destruction can be one of the ways to treat pancreatic necrosis. This leads to a rapid cleansing of the cavities and is an objective method of monitoring the stages of treatment.

We present a case of successful treatment of infected pancreatic necrosis using minimally invasive, percutaneous, X-ray endovascular methods. Procedures performed: superselective embolization of the upper and lower pancreaticoduodenal arteries, embolization of the gastroduodenal artery, embolization of the splenic artery, selective catheterization and embolization of the left gastric artery with microemboli and coils.

Keywords: pancreas, acute pancreatitis, pancreatic necrosis, parapancreatitis, percutaneous drainage, endoscopic sequestrectomy, endovascular surgery

For citation Rogal ML, Agakhanova KT, Yartsev PA, Kokov LS, Bayramov RSh, Dzhagrayev KR, et al. Complex Application of Minimally Invasive Methods for the Treatment of Complicated Acute Severe Pancreatitis. *Russian Sklifosovsky Journal of Emergency Medical Care*. 2022;11(3):516–524. https://doi.org/10.23934/2223-9022-2022-11-3-516-524 (in Russ.)

Conflict of interest Authors declare lack of the conflicts of interests

Acknowledgments, sponsorship The study has no sponsorship

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ALV – artificial lung ventilation
BP – blood pressure
CRP – C-reactive protein
CT – computed tomography
HR – heart rate
PE – pulmonary embolism
RR – respiratory rate
XRVG – X-ray video guidance

INTRODUCTION

Acute pancreatitis accounts for 25% of all diseases of the abdominal organs, of which destructive forms are 15–20% of all cases of acute pancreatitis. The mortality in this group of patients reaches 30%, and when infectious complications develop it reaches 85%.

In the phase of destructive complications, minimally invasive interventions under the ultrasound guidance in the treatment of pancreatic necrosis are used along with other closed and open methods of percutaneous drainage and sequestrectomy (Russian clinical guidelines, 2014). In order to provide optimal access to fluid accumulations with sequesters after primary drainage under ultrasound guidance, as a rule, it becomes necessary to dilate the drainage channel to a diameter sufficient to remove sequesters.

There are several options for solving this problem. The first method consists in successive dilatation of the drainage channel with the help of bougie of increasing diameter up to 10–20 mm according to the Seldinger method with the installation of appropriate drainage tubes during one or several procedures carried out at intervals of up to several days [1]. In the second method, drains with a diameter of up to 20 mm are installed simultaneously [2]. The choice of method depends on the volume of retroperitoneal necrosis and the completeness of sequestration.

After installing drainage tubes with a diameter of 10 to 20 mm and creating channels for access to sequestration zones, they proceed to the second stage, the removal of sequesters. There are two main techniques to do this:

1. Through the formed canals with a diameter of up to 10–20 mm, using endoscopic equipment under visual guidance, the destruction cavities are inspected, free sequesters are identified and removed through the same canal with an endoscopic basket, forceps or loop with or without preliminary fragmentation [3, 4].

2. Through the formed channels with a diameter of up to 20 mm, using special tools of sufficient length, which design allows opening the branches in the cavities through narrow extended channels, capture free sequesters under X-ray guidance with their subsequent removal through the channel [2].

Thus, minimally invasive methods of percutaneous drainage of infected destruction zones under ultrasound guidaance, followed by endoscopic retroperitoneoscopy, sequestrectomy, sanitation of cavities using traditional endoscopic instruments or specially designed instruments, can be independent methods of surgical treatment of patients with severely infected pancreatic necrosis and parapancreatitis.

In the presence of infected pancreatic necrosis, the risk of developing hemorrhagic complications due to erosion of the walls of the vessels involved in the inflammatory process and the formation of false aneurysms of these vessels increases significantly. In this case, most often false aneurysms are formed during the destruction of the wall of the splenic, gastroduodenal artery and their branches. L.A. Neledov et al. (2019), referring to the summary data of foreign researchers, note that the incidence of pseudoaneurysms in acute pancreatitis is 1.3–10%, and mortality can reach 13–24% [5].

The vast majority of patients with bleeding from the upper gastrointestinal tract are examined by endoscopic methods, and if sources of bleeding are found, hemostasis is performed endoscopically. In case of recurrence of bleeding and high risks of death during abdominal surgery, the service of endovascular surgery comes to the rescue. Modern methods of X-ray surgery make it possible to visualize almost all arteries supplying the upper parts of digestion, to identify direct or indirect radiographic signs of bleeding. Before endovascular hemostasis, much attention should be paid to indications and contraindications, assessment of risks and complications when performing such a manipulation. The presence of variations of catheters and conductors, embolizing material, experience and skills of an endovascular surgeon is the key to the success of the manipulation in the treatment of gastrointestinal bleeding.

The main indication for endovascular embolization for bleeding from the upper gastrointestinal tract (GIT) is the impossibility of determining the source of bleeding and achieving hemostasis by conservative and endoscopic methods in the presence of ongoing bleeding or the threat of its recurrence, requiring urgent surgical care, on the one hand, and severe condition on the other hand that excludes surgery or greatly increases the risk of it.

International guidelines for the treatment of bleeding and for the management of patients with non-variceal bleeding from the upper gastrointestinal tract (GIT) recommend that surgical intervention or endovascular hemostasis be performed only after recurrent bleeding and repeated endoscopic hemostasis. However, this tactic is unacceptable for patients with severe concomitant pathology and high operational risk, for whom recurrent bleeding is often unbearable, especially when operations are undertaken in its course.

There are no absolute contraindications to endovascular intervention. The special attention should be given to the group of patients with allergic reactions to iodine-containing drugs, pregnant women and patients with kidney disease. X-ray surgical interventions are often an alternative to traditional surgery and are performed as a "desperate attempt". An absolute contraindication to their use is only the agonal state of the patient and a high risk of developing necrosis of the wall of a hollow organ.

The aim of the study is to show the possibilities of combined use of various minimally invasive methods of interventional radiology — percutaneous drainage of foci of pancreatogenic destruction under ultrasound control and X-ray endovascular selective embolization of regional vessels in the surgical treatment of a patient with infected pancreatic necrosis and a high risk of developing hemorrhagic complications.

Here is a clinical observation of a patient who underwent percutaneous drainage and transfistula endoscopic sequestrectomy. At the stages of surgical treatment, repeated bleeding and the formation of acute false aneurysms of various regional arterial vessels occurred, which required sequential embolization of the splenic artery, left gastric artery, gastroduodenal artery, superior and inferior pancreatoduodenal arteries.

Clinical observation

A 32-year-old male patient S. was admitted to the Emergency Department of the N.V. Sklifosovsky Research Institute for Emergency Medicine on the 2nd day from the onset of the disease with complaints of nausea and pain in the upper abdomen. Upon examination, the patient's condition was moderate. The respiratory rate (RR) was 16 breaths per minute. The heart rate (HR) was 89 beats per minute, the blood pressure (BP) 130/85 mm Hg. The tongue was wet. The abdomen was soft on palpation, painful in the mesogastric region. Peristalsis could be heard. Peritoneal symptoms were negative. Bowel and bladder functions were normal. The urine was light. Blood hemoglobin upon admission 125 U/l. Blood amylase 1500 U/l. C-reactive protein (CRP) 225 mg/l. Ultrasound of the abdominal organs: signs of acute pancreatitis, parapancreatitis, paranephritis on the right, paracolitis. Plain radiography of the abdominal cavity showed no pathological changes.

After the examination, the diagnosis was acute severe pancreatitis, large-focal pancreatic necrosis. The patient was hospitalized in the intensive care unit. The complex intensive infusion therapy up to 3,500 ml per day, antisecretory (octreotide 900 mcg per day) therapy, correction of protein and electrolyte disorders. Despite complex therapy, the patient's intoxication increased, negative dynamics of the condition was noted (hyperthermia up to 39.4°C, increasing respiratory failure, which required artificial lung ventilation (ALV), blood WBC 14.7×10^9/l). On the 5th day from the onset of the disease, the patient showed US and CT signs of large-focal pancreatic necrosis, parapancreatitis, infiltrative-destructive changes in the retroperitoneal tissue (Fig. 1).

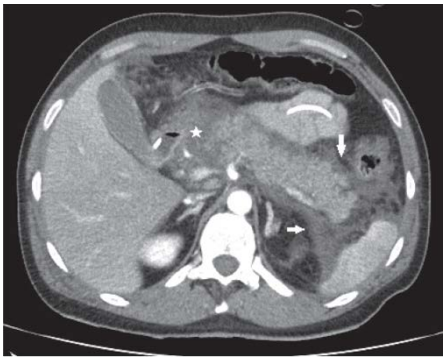

Fig. 1. Computed tomography of the abdominal cavity with contrast enhancement, axial projection. Macrofocal pancreatic necrosis (marked with an asterisk), parapancreatitis, infiltrative-destructive changes in retroperitoneal tissue (marked with arrows)

On the basis of clinical and laboratory data, as well as the results of ultrasound and CT, the patient was diagnosed with severe acute pancreatitis with a progressive course, an increase in the volume of acute retroperitoneal fluid accumulation and the early development of infected parapancreatitis. Due to the ineffectiveness of complex conservative therapy, a decision was made on the need to use a minimally invasive surgical method of treatment by percutaneous drainage of the area of pancreatogenic destruction under ultrasound guidance. On the 5th day (from the moment of hospitalization), under local anesthesia, the patient underwent percutaneous drainage of the retroperitoneal zone of pancreatogenic destruction under ultrasound guidance (a pig tail 9 Fr drainage tube was installed). We evacuated 1000 ml of brown discharge, liquid with signs of infection. The bacteriological test of the obtained discharge, liquid from the focus of destruction was carried out (*Escherichia Coli*, sensitive to meropenem, was revealed).

Antibacterial therapy was added to the treatment (meropenem 2 g tid and Tigecycline 150 mg on the first day, then 50 mg bid On the comparison ultrasound and CT scan of the abdominal cavity on the 23rd day from the onset of the disease and the 21st day from the moment of admission, there was a negative dynamics in the state of the pancreas, the spread of fluid accumulation in the retroperitoneal tissue, the left type (Fig. 2 *A* , *B*).

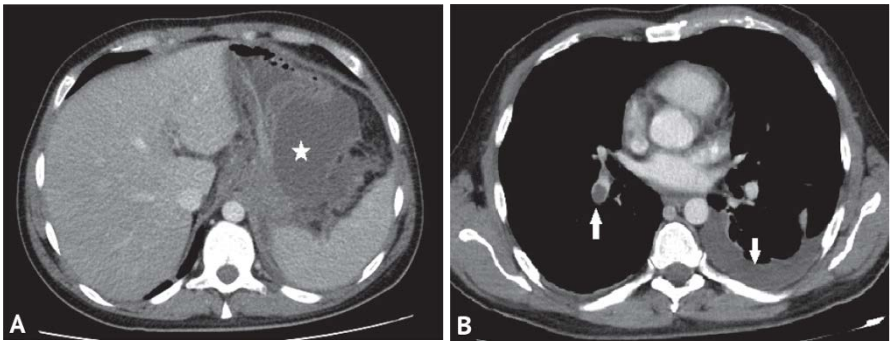

Fig. 2. Computed tomography of the chest and abdomen with contrast enhancement, axial projections. Formation of circumscribed fluid accumulations in the parapancreatic and paragastric space (marked with an asterisk in Fig. 2A). In the lumen of the right lower lobe branch of the pulmonary artery, multiple contrasting defects (thromboemboli) and left-sided hydrothorax (marked with an arrow, Fig. 2B) are determined

On the 23rd day from the onset of the disease, under local anesthesia, additional drainage of the zone of pancreatogenic destruction was performed with three pig tail 12 Fr drains. On the 26th day from the onset of the disease and on the 24th day from the moment of admission under endotracheal anesthesia, drains were replaced and corrected in the areas of pancreatogenic destruction under X-ray video guidance (XRVG) with vacuum aspiration sequestrectomy, drainage tubes with a diameter of 36 Fr were installed. *Escherichia coli*, sensitive to meropenem, imipenem, was found, antibiotic therapy was prescribed (imipenem 2 g tid intravenously (IV), quinizol 100.0 ml bid IV). Infusion-transfusion therapy was also carried out: fresh frozen plasma, erythrocyte mass, antispasmodic (platifillin 2 ml tid intramuscularly), anticoagulant (heparin 2500 U 4 times a day subcutaneously), anti-inflammatory therapy, immunocorrective and prebiotic (sextophage 2 vials tid, Linex 1 caps. tid) therapy, parenteral and enteral

nutrition (Kabiven, Advanced, Nutridrink, Nutrizone), correction of hypoalbuminemia (albumin solution intravenously 20% 100.0).

On the 33rd and 46th days from the onset of the disease, a planned replacement and correction of drains under X-ray video guidance was performed. Intensive therapy continued, washing the cavities with antiseptic solutions (an aqueous solution of chlorhexidine, a solution of dioxidine 3–4 times a day).

On the 45th day from the onset of the disease, due to the planned transfistular endoscopic sequestrectomy in the projection of the hilum of the spleen and a high risk of bleeding, X-ray endovascular embolization of the splenic artery was performed to reduce blood flow (Fig. 3 *A*, *B*).

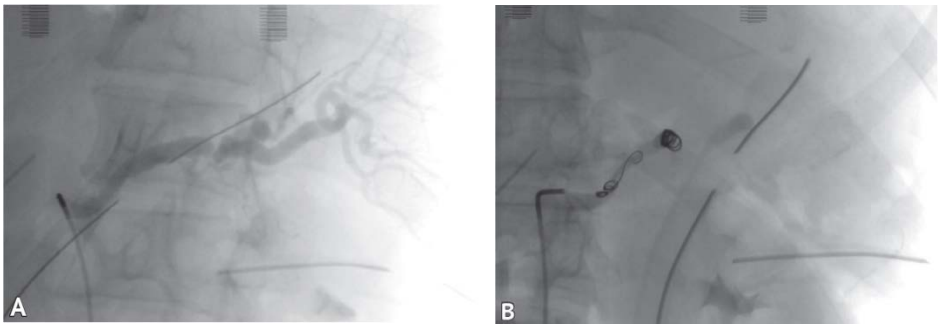

Fig. 3. Angiography of the splenic artery. A - The splenic artery third is passable, in the middle of the splenic artery there is an area of significant spasm; B - Embolization of the proximal and middle sections of the splenic artery with microcoils COOK 7×8 mm and two COOK 7/3×9 mm. Comparison angiograms: occlusion of the splenic artery in the proximal and middle thirds

However, despite the successful embolization of the splenic artery, on the 46th day from the onset of the disease, when performing sequestrectomy, about 1,000 ml of blood from the zone of pancreatogenic destruction was noted. The destruction zone from the bottom is tightly plugged with narrow gauze swabs through the formed drainage channel. On the 50th day from the moment of the disease, the swabs were removed without signs of bleeding, drainage tubes 30 and 36 Fr were reinstalled into the cavity. The recurrence of bleeding through the drainage tubes occurred on the 62nd day after the disease. The tubes were removed, the cavity from the bottom was tightly plugged with narrow gauze swabs through the formed drainage channel, the bleeding was arrested.

On the 62nd day, to identify the source of bleeding, the patient underwent repeated angiography, which revealed an extravasation area in the system of the left gastric artery, so it was embolized (Fig. 4 *A*, *B*, *C*).

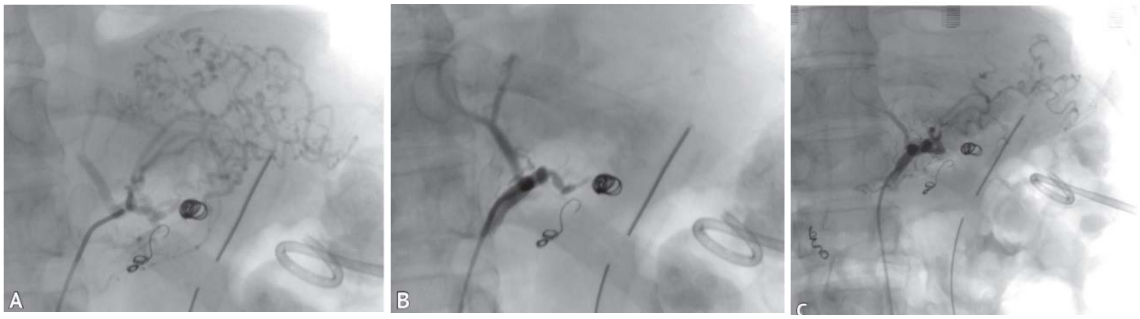

Fig. 4. A — the splenic artery was previously embolized at two levels with microcoils in the proximal and middle third, the mouth of the splenic artery is contrasted. The left gastric artery is well developed, in the distal section there is an area of hypervascularization; B — selective catheterization and embolization of the left gastric artery with microemboli and coils; C — on comparison angiograms: the distal vessels are not contrasted, occlusion of the left gastric artery in the proximal third

On the 68th day, gastrointestinal (GI) bleeding developed. The esophagogastroduodenoscopy revealed fibrinous gastritis, endoscopic picture corresponded to superficial necrosis of the mucosa, acute ulcers of the proximal part of the antrum, which, apparently, was the result of ischemic disorders after embolization (Fig. 5 *A*, *B*).

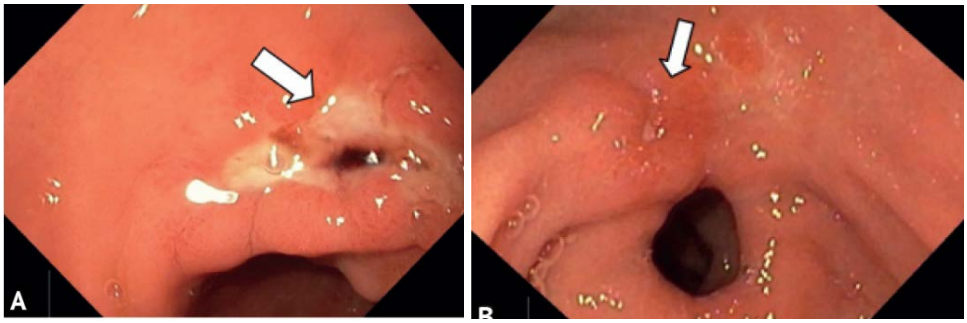

Fig. 5. Endophoto. A - primary study (the arrow indicates an acute ulcer of the antrum of the stomach with signs of ongoing bleeding); B—comparison EGDS in 7 days (the arrow indicates an ulcer in the stage of incomplete scarring)

On the 68*th* day from the onset of the disease after the removal of the swab, the repeated arterial bleeding occurred from the area of pancreatogenic destruction. The cavity from the bottom was tightly packed for the third time with narrow gauze swabs through the formed drainage channel and the bleeding was arrested. CT scan with intravenous contrast revealed a false aneurysm of the branches of the gastroduodenal artery with a diameter of 2 cm (Fig. 6 *A*, *B*).

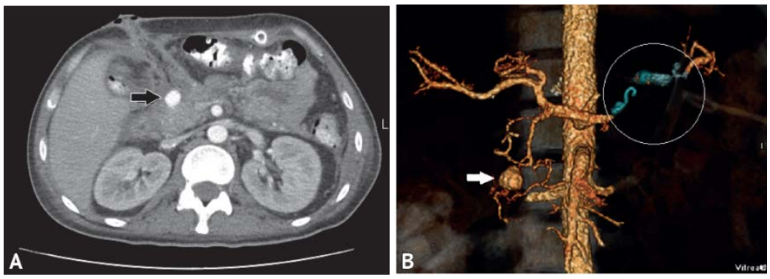

Fig. 6. CT scan of the abdominal cavity with contrast enhancement: A — axial view; B - 3D reconstruction. Condition after filling the drainage canal. A spherical pseudoaneurysm of the gastroduodenal artery is determined in the area of the bottom of the drainage channel (arrows in Fig. 6A and 6B). Spiral emboli in the lumen of the splenic artery with reduced blood flow (highlighted in a circle in Fig. 6B)

On the 68th day from the onset of the disease, X-ray endovascular embolization of the gastroduodenal artery was performed in order to exclude a false aneurysm from the blood flow (Fig. 7 *A* , *B*).

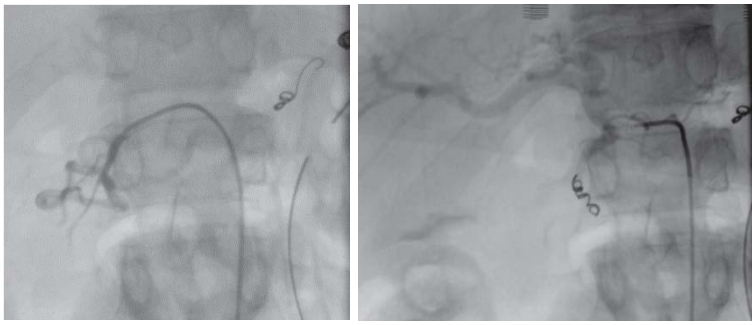
Fig. 7. Angiography of the gastroduodenal artery. A - false aneurysm of the gastroduodenal artery; B - condition after coil embolization, aneurysm is not contrasted

The comparison ultrasound and CT revealed an aneurysm with arterial blood flow 1 cm in diameter (Fig. 8 *A*, *B*).

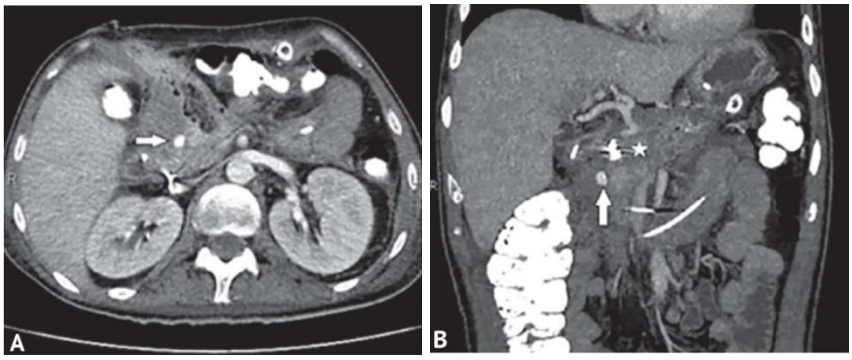

Fig. 8. Computed tomography of the abdominal cavity with contrast enhancement. A - axial projection; B - front view. An aneurysm of the gastroduodenal artery system with a diameter of 10 mm is preserved (arrows in Figs. 8A, 8B). Spiral emboli in the lumen of the gastroduodenal artery (asterisk in Fig. 8B)

On day 72 from the onset of the disease, superselective X-ray endovascular embolization of the superior and inferior pancreaticoduodenal arteries was performed (Fig. 9 A, B).

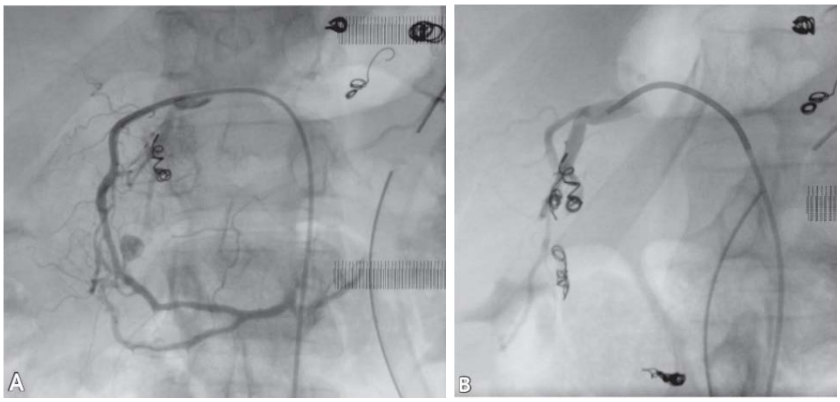

Fig. 9. Angiography of the gastroduodenal artery. A - the false aneurysm is contrasted; B - condition after embolization, the false aneurysm is not contrasted

Three days later, the swabs were removed from the area of pancreatogenic destruction, no active ongoing bleeding was noted. The cavity was refilled.

The patient had hyperthermia up to 39ºC. The ultrasound (on the 92nd day) revealed signs of a spleen abscess, confirmed by CT of the abdominal cavity (Fig. 10 *A*, *B*).

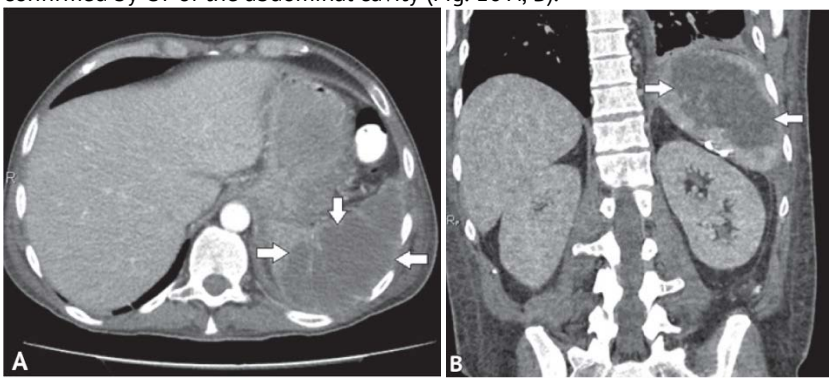

Fig. 10. Computed tomography of the abdomen with contrast enhancement. A - axial projection; B - front view. The formation of extensive areas of liquid density in the spleen (arrows)

On the 93rd day from the moment of the disease, percutaneous drainage of the spleen abscess was performed under ultrasound guidance with tubes with a diameter of 12 Fr and 24 Fr. We evacuated 100 ml of cloudy hemorrhagic discharge with signs of infection.

On the 94th–97th day, a planned replacement of swabs in the areas of pancreatogenic destruction with 24 Fr tubes was made, taking into account the absence of bleeding.

Fistulography on the 99th day did not reveal any communication of the destruction zone with hollow organs.

On the 106th day from the onset of the disease, fistulography showed that the cavity was obliterated, drainage from the retroperitoneal space was removed. Fractional washing of the spleen abscess was carried out through the lumen of the tube with an aqueous solution of chlorhexidine 5-6 times a day. Drainage tubes from the cavity of the spleen abscess were removed on the 121st day from the onset of the disease.

The comparison Doppler ultrasound of the veins of the lower extremities on the 121st day revealed signs of non-occlusive thrombosis of the left common femoral vein, a floating thrombus of a high degree of mobility, non-occlusive thrombosis — recanalization of the sural veins. Given the inability to conduct adequate anticoagulant therapy due to the risk of hemorrhagic complications, a history of pulmonary embolism (PE), a high degree of thrombus mobility, an OPTEASE cava filter was installed in the patient to prevent recurrence of fatal PE (Fig. 11).

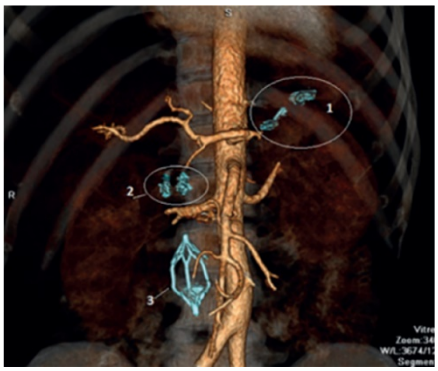

Fig. 11 Computed tomography and angiography. 3D reconstruction: condition after embolization of the splenic artery (1), gastroduodenal artery, superior and inferior pancreaticoduodenal arteries (2), installation of a cava filter (3). Data for aneurysm or extravasation not received

On the 125th day, the control CT scan of the abdominal cavity showed positive dynamics in the state of the pancreas, the aneurysm of the gastroduodenal artery decreased in size. In the course of complex treatment in combination with minimally invasive methods of treatment, the patient's condition stabilized, laboratory parameters returned to normal (Fig. 12).

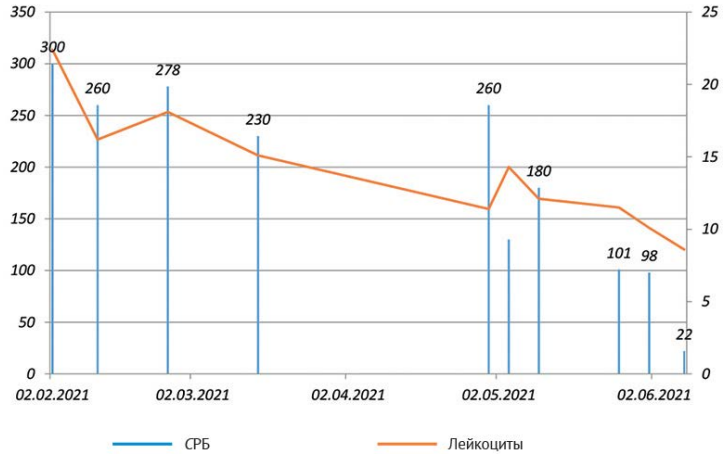

Fig. 12. Chart of indicators of blood WBC and C-reactive protein (CRP)

In the twentieth century, promising minimally invasive methods of surgical treatment of infected pancreatic necrosis are being applied and improved. Thus, against the background of the complex conservative and minimally invasive surgical treatment under the ultrasound guidance, endoscopy and X-ray video guidance with the use of endovascular surgery, a significant positive trend in the patient's condition was observed. On the 129th day from the moment of admission and on the 131st day from the onset of the disease, the patient was discharged from the hospital in a satisfactory condition for outpatient treatment.

CONCLUSIONS

This clinical observation demonstrates the numerous and diverse nature of local and systemic complications of infected pancreatic necrosis, shows the high efficiency of using minimally invasive percutaneous surgical methods under ultrasound and X-ray video guidance for full sanitation and sequestrectomy in unrestricted infected parapancreatitis, as well as the possibility of using X-ray endovascular methods in the development of hemorrhagic complications. At the same time, timely detection of signs of bleeding and preventive embolization of vessels in the area of pancreatogenic destruction can fundamentally change the outcome of the disease. We note the high clinical effectiveness of the use of percutaneous methods of drainage of foci of pancreatogenic destruction in combination with X-ray endovascular embolization of regional vessels in the surgical treatment of infected pancreatic necrosis in patients with a high risk of developing hemorrhagic complications and arrosive bleeding arrest.

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Received on 24.11.2021

Review completed on 10.03.2022

Accepted on 29.06.2022