Diagnostic algorithm in a surgical treatment of acute necrotizing pancreatitis

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Key words: acute necrotizing pancreatitis, diagnostic algorithm, estimation of severity of the case, differential staged tactics, surgical treatment

Introduction

Problem of diagnosis and treatment of severe acute pancreatitis (AP) is one of the most controversial in abdominal surgery [1, 3, 4]. Separation of patients with severe course AP in the early stages of the disease can actually improve the results of their treatment. This requires improving prognostic criteria based on pathophysiological mechanisms of inflammation [10, 12].

In the problem of early AP diagnosis today there are many outstanding issues, although the effects of the disease depend heavily on accurate early diagnosis and timely treatment [6, 11]. According to many authors, in the diagnosis of acute necrotizing pancreatitis (ANP) the significant role is played by research data [5, 10]. But it also noted that to verify the ANP diagnosis, staging and causes of disease it is necessary to use instrumental methods: radiography of the chest and abdomen, ultrasound, endoUSD, CT, MRI, MRCGP, angiography of blood vessels of the pancreas, ERPCG, diagnostic laparoscopy [8, 9, 13]. For the final objective of stratification of patients with pancreatic necrosis severity of their condition in 11 of the world published guidelines of tactics of patients with AP recommended as standard, complementary use of the scale of APACHE II, determining the content of C-reactive protein (CRP) in the blood and CT with intravenous contrast enhancement [1]. Despite the use of existing laboratory and instrumental methods, multivariate clinical and laboratory prognostic scales, the main cause of high mortality in necrotic forms AP is late diagnosis and inadequate assessment of the severity of the disease [7, 11].

Today in Ukraine and abroad there is no single diagnostic and therapeutic doctrine regarding ANP. The subject of discussion is the prediction, diagnosis, selection of indications and timing of the surgery on ANP, scope and techniques of surgical interventions, as well as the conservative treatment, including prevention of infectious complications, inhibition of secretory activity of the pancreas, organization of enteral nutrition and parenteral nutrition, methods of detoxification, etc. [1, 3, 9].

Thus, increasing number of patients with ANP, unsatisfactory results of treatment, contradictions opinions of scientists on the diagnosis and surgical treatment, place of conservative treatment, prevention of complications determine the urgency of the problem and encourage improving the diagnostic measures, evaluation of severity of patients, justification indication for use of mini-invasive and "open" surgery in clinical practice.

The aim of research is to improve the results of surgical treatment of ANP by developing and implementing diagnostic algorithm, compliance of pathogenetically reasonable staged differentiated tactics of patients depending on the phase, variations of the disease.

Materials and methods

All clinical study is conducted at the National Institute of Surgery and Transplantation n. a. A. A. Shalimov of the NAMS of Ukraine. Clinical material belongs to 569 patients operated on ANP. The control group included 182 patients. The main group included 387 patients, where we had to change strategy in the diagnostic approaches, conservative and surgical treatment, developed and introduced new methods of diagnosis, conservative and surgical treatment.

Age of patients — from 18 to 79, women — 108 (18.98%), men — 461 (81.02%). Patients aged from 41 to 50 years dominated, which is natural for acute pancreatic diseases.

The majority — 521 (91.56%) patients — was of working age (60 years). Distribution of patients in both groups by etiological factor is presented in Table 1.

Table 1

Etiological structure of ANP in the comparison groups

ANP etiology	Number of observations in the groups				P
	control		main		
	abs.	%	abs.	%	
Alcohol	92	50,55	202	52,20	>0,05
Biliary	73	40,11	151	39,02	>0,05
Postoperative	3	1,65	7	1,81	>0,05
Non-defined	14	7,69	27	6,98	<0,05
Total	182	100	387	100	

During the stratification of patients in practice, we used our adapted classification of clinical ANP forms adopted at the International Symposium in Atlanta (1992):

1. Interstitial AP.

2. Necrotizing AP:

a) pancreatic necrosis — aseptic and infected;

b) parapancretic accumulation of fluid — aseptic and infected;

c) pancreatic pseudocyst;

d) pancreatic abscess.

Ultrasonography of the abdomen is considered as screening method. The study was performed using the apparatus "Aloka SSD-630" (Japan) in real time. The device is equipped with a convex transducer with a frequency of 3.5 MHz, linear transducer with a frequency of 3.5 MHz, designed for percutaneous manipulations (puncture, therapeutic and diagnostic drainage).

Endoscopy of stomach, duodenum, in the difficulty of differential diagnosis — ERPCG was performed using duodenoscopes with lateral optics IF-1T and IF-1T10 of the company «Olympus» (Japan) with a diameter of 1.7 mm working channel, using electronic-optical converter «Telemax» (Hungary).

Vascular angiographic study of hepatopancreatoduodenal area is highly effective method of the diagnostics of Wirsung's duct hemorrhage and necrotic lesions of the pancreas. Wirsung's duct hemorrhage is caused by the presence of false

aneurysms arteries of hepatolienal pool, localized in the pancreatic tissue and combined with its strait, is one of the causes of bleeding from the upper bowel, which is the hardest diagnosed.

Computed X-ray tomography was performed using apparatus «Somatom-CR» company «Siemens» (Germany), spiral CT machine «Somatom Plus 4» («Siemens», Germany). To gain the effect, we used a non-ionic contrast agent containing iodine 300 mg/mL, 350 mg ml. The contrast agent was injected into the ulnar vein at a speed of 3.4 ml/sec via automatic injector «Medrad» (Belgium). Delay of scanning was 30-40 sec. Slice thickness and step table were determined depending on the pathological process, volume scanning — in native studies. According to the indications, we used multidetector CT (MDCT) and MRCGP.

Laparoscopic intervention was performed using video endoscopic equipment and set of equipment for endoscopic surgery of company «Karl-Storz-Endoskope» (Germany).

Results and discussion

Assessment of the severity of the patients and AP prognosis on admission and treatment dynamics, given the clinical and laboratory data and instrumental methods of research, wsa carried out by the integrated scales Ranson and APACHE II (ANP — Ranson ≥ 3, APACHE II ≥ 8).

Diagnosis of ANP included general clinical tests, biochemical studies, specific activity determination were amylase, lipase levels. For severe disease we carried out: biochemical, bacteriological, cytology research of exudate (subject to the puncture) antibioticogram analysis, bacteriological examination of blood.

Severe ANP, sepsis is accompanied by a significant increase in CRP content. As a result, its determination is more convenient marker of the severity of inflammation unlike such as erythrocyte sedimentation rate, leukocyte count, leukocyte analysis formula. Diagnostic questions on the use of CRP and procalcitonin (PCT) at ANP are insufficiently studied, so we conducted a study to establish the diagnostic value of PCT and CRP content in the serum of patients with ANP.

To evaluate the clinical value of methods for determining the content of CRP and PCT during the diagnostics we calculated the sensitivity of the two tests in patients with ANP of the different groups. Thus, the concentration of CRP was increased in 88.6% of patients with ANP, on this basis quantitative test sensitivity of determination of CRP content was 88.6%. The sensitivity of the method of determining PCT, based on similar computations in the diagnosis ANP, was 51.3%.

Despite significant (P<0.05) differences in sensitivity performance of two tests used to diagnose ANP, weak positive correlation between them should be noted. Thus, the index of Spearman's rank correlation between levels of CRP and PCT was 0.41, performance difference was significant (P<0.001).

So, using the test defining PCT content, unlike the test to determine the level of CRP, we may identify patients with ANP and purulent-septic complications. Thus, when comparing two groups of patients with aseptic and septic pancreatitis, sensitivity test to determine the contents of PCT was 73.4%, test to determine the level CRP — 42.1%. Their specificity was respectively 93.9 and 85.7%. Based on analysis of the indicators, we have concluded that for ANP patients who have purulent-septic complications, test to determine the content of PCT (index of diagnostic efficiency (IDE) — 83.9%) is more effective than CRP test where IDE is equal to 46.9%.
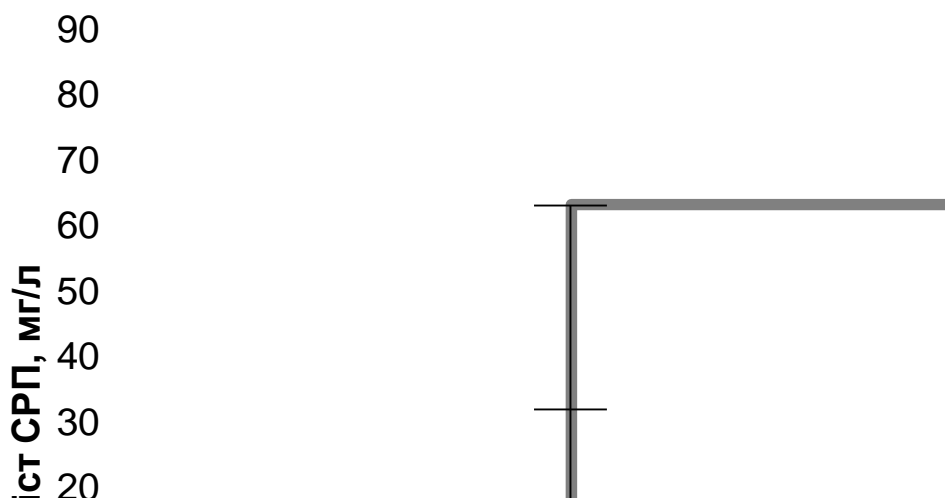

Fig. 1. Example of the typical dynamics of CRP and PCT in patient A. after laparotomic drainage of the parapancreatic fiber.
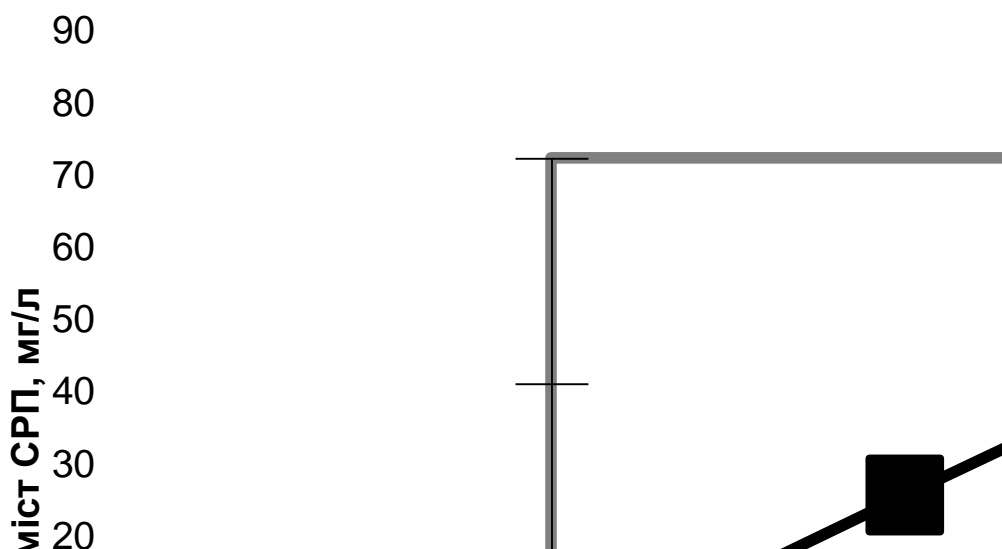
Fig. 2. Example of the typical dynamics of CRP and PCT in patient B. with purulent-septic necrotic pancreatitis after laparotomic drainage of the parapancreatic fiber followed by the appearance of peritonitis and execution relaparotomy.

Fig. 1 shows the performance characteristics of a patient with the infected ANP. In one patient (Fig. 2) before and after primary laparotomy until the 6th day we observed characteristic dynamics of CRP and PCT, however, on the 7th day it sharply increased, indicating the occurrence of postoperative purulent-septic complications, which is confirmed upon the second laparotomy.

Studying the typical dynamics of CRP and PCT content aims to clarify and detail the previous total analysis of groups of patients. It should be emphasized that the increase in CRP concentration is observed in almost any surgical intervention, while the contents of PCT in the performance of mini-invasive intervention is unchanging, while in a volume intervention — is slightly increased (up to 2 ng/ml).

Determination of CRP has important diagnostic value in necrotizing pancreatitis without septic complications, PCT — in septic pancreatitis. However, in the appearance of purulent-septic complications, to verify the diagnosis level of CRP has additional significance, especially its increase.

Thus, according to the results of the studies, in 88.6% of patients diagnosed with ANP we marked increase (more than 6 mg/L) of CRP in serum. Upon purulent-septic

complications, CRP is significantly greater (P<0.0003) in patients with septic pancreatitis (21.3 mg/L) than in patients with aseptic course of the disease (16.3 mg/L). In necrotic pancreatitis with septic complications, unlike aseptic form, we noted significant (P<0.0001) improvement of PCT. For the diagnosis of necrotizing pancreatitis complicated with purulent-septic processes it is more effective to define the content of PCT (IDE 83.9%) than CRP (IDE 46.9%).

Instrumental methods included: review X-ray of the abdomen, chest, ultrasound of the abdomen, EFGDS, endoUSD. Further, depending on the nature of disease, were used: spiral computed tomography (SCT) with bolus contrast enhancement, percutaneous puncture under ultrasound guidance, puncture under control of the endoUSD, ERPCG, angiography, laparoscopy.

Ultrasonography of the abdomen was performed by the standard method. We studied the state of the liver, bile ducts, pancreas, got the data related to the concomitant diseases of the abdominal cavity. The presence of acute postnecrotic cysts of the pancreas greatly aggravated intraorganic blood flow in the body due to compression of blood vessels. Puncture of the pathological cell was performed with a needle Chiba, drainage — by Seldinger. For instantaneous drainage (provided the surface location of abnormal cavities) we used stylet catheter. Depending on the location of the pathological formation and its size, access was performed, bypassing the vessel and, if possible, hollow abdominal organs. Mini-invasive interventions were performed through the liver, digestive and gastro-splenic ligament colon, small seal, in a translumbal way, if it was impossible to use other approaches — in a transgastric way. In the therapeutic puncture maximum of content was removed, repeatedly washed with oral antiseptic solution, particularly ozonized by isotonic sodium chloride solution, betadine. Before obtaining the antibioticogram, we administered the broad spectrum antibiotics. During the execution of external omental drainage under ultrasound we gave preference to the introduction of two drainages, which allowed to create aspiration-flushing system.

Endoscopy of the stomach and duodenum, as well as upon the difficulties of differential diagnosis — ERPCG, was conducted strictly on an empty stomach. We

examined the mucous membrane of the stomach and duodenum, special attention was paid to the size and structure of the large duodenal papilla. With signs of biliary pancreatitis, therapeutic manipulations of research were added: endoscopic papillosphincterotomy, lithoextraction, suprapapillary choledochoduodenostomy. During the execution of ERPCG we used solution with mass fraction of 76% verografin or 75% urografin as a contrast agent.

Vascular angiographic study of hepatopancreatoduodenal area is highly effective method of the diagnostics of Wirsung's duct hemorrhage and necrotic lesions of the pancreas. In angiogram upon acute bleeding contrast formation is defined in projection of the pancreas, which often has a connection with the main pancreatic duct, there is a way out of contrast material into the lumen of the duodenum. Besides the bleeding episode aneurysmatic formation may not be filled by contrast fliud, and the only angiographic sign is a "break of contrasting" of the supply vessel and the presence of avascular zone in the projection of the aneurysm.

SCT was performed on the machine Somatom Plus4 («Siemens», Germany). In the films we were receiving images of internal organs in a cross section of a given depth interval sections.

By the severity of pancreatic changes and due to the extrapancreatic changes, SCT-semiotics of various forms of pancreatitis is defined.

Type 1. Interstitial pancreatitis — increased size of the pancreas, reduced density of the organ parenchyma, blurred contours, diffuse increased density of the parapancreatic fiber (Fig. 3).
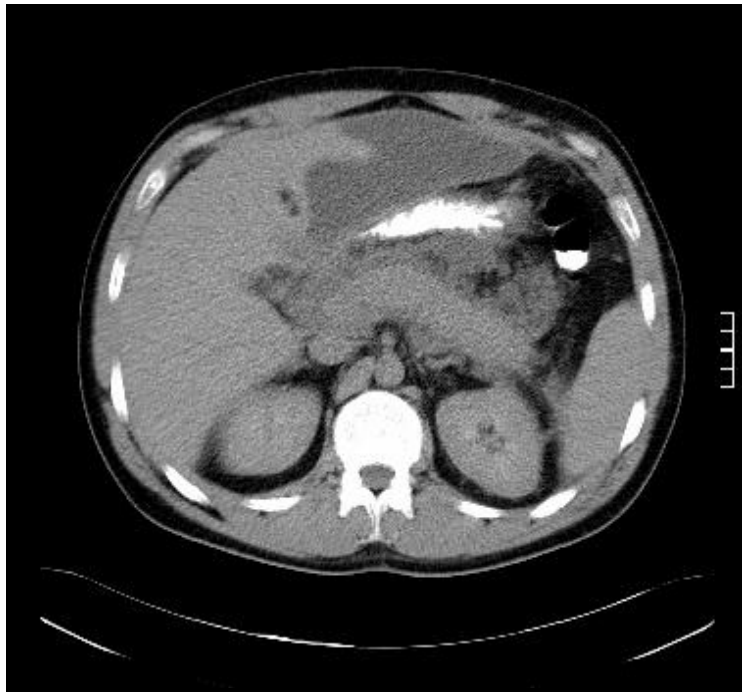
Fig. 3. Interstitial form of pancreatitis. Reduced density of the organ parenchyma, blurred contours, increased density of the parapancreatic fiber due to swelling. Fluid accumulation in the left subhepatic recess.

Type 2. <u>Necrotizing pancreatitis</u> — increased size, lower density of the pancreatic parenchyma, foci with density of 20-30 H. units, expressed extrapancreatic changes of different distribution. By the nature of the changes in the pancreatic parenchyma, parapancreatic tissue and serous cavities are distinguished:

a) *pancreatic necrosis with an area of necrosis of the pancreas 30% —* increased size of the organ, reduced density of parenchyma, foci of significant decrease in the pancreatic tissue density with a diameter of 10 mm, presence of liquid in the omental bursa, pleural cavity, abdomen, swelling and infiltrative-necrotic changes in the parapancreatic and retroperitoneal tissue, most often — front pararenal and paracolic (Fig. 4);
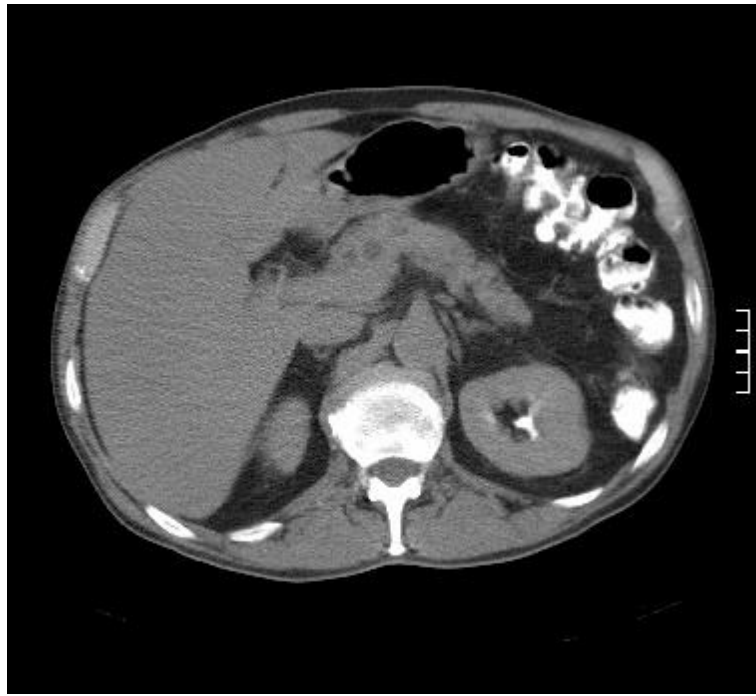
Fig. 4. SCT. In the projection of the pancreatic head, foci of necrosis as the lower density parenchymal zones are detected.

b) *pancreatic necrosis with an area of necrosis of the pancreas from 30 to 50%* — increased size of the organ, expressed blurred contours, foci of decrease in the pancreatic tissue density with a diameter of 10-30 mm, liquid and infiltrative-necrotic changes in the omental bursa, parapancreatic and retroperitoneal tissue — front, rear pararenal, paracolic tissue (Fig. 5);

Fig. 5. SCT. Pancreatic necrosis with an area of necrosis of the pancreas from 30 to 50%. Multifocal pancreatic necrosis.

c) *pancreatic necrosis with an area of necrosis of the pancreas over 50%* — increased size of the organ, blurred contours of the pancreas, significant reduction in the density of tissue, multifocal changes or edge defect with a diameter of more than 30 mm, expanding to two or three anatomical parts of the pancreas (head, body, tail); expansion of extrapancreatic changes according to multifocal pancreatic necrosis (Fig. 6, 7).
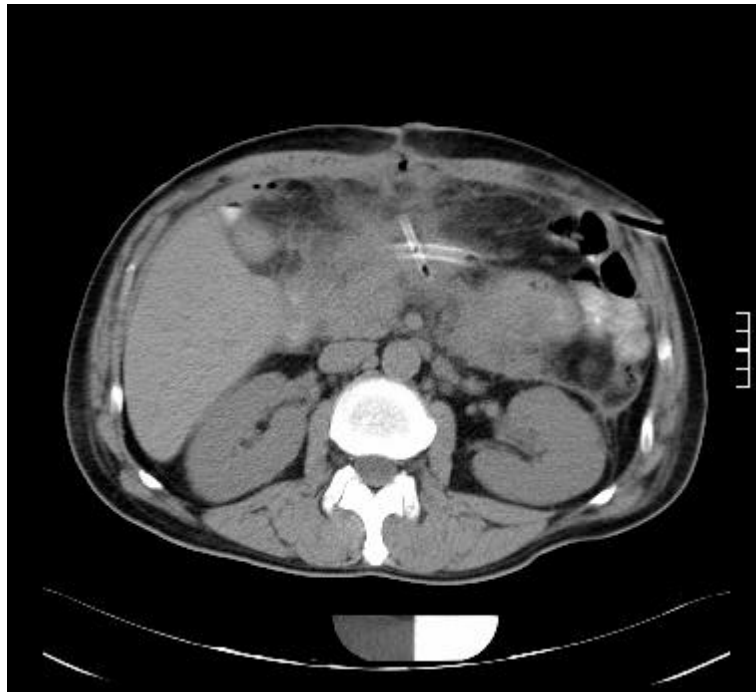
Fig. 6. ANP. Infected pancreatic necrosis.

Fig. 7. SCT. Spread of inflammation in the front and rear pararenal area.

In the projection of switching pancreatic head into the body, there is an area of significant decrease in density of parenchyma (up to 18 H. units). In intravenous contrast, accumulation of contrast material in this area is not observed. The preserved part of the pancreas is increased, density of its tissue being reduced. Changes in the

parapancreatic tissue in the form of consolidation and accumulation of fluid in the omental bursa (see Fig. 5).

In the scan drainage can be seen, installed in the zone of destruction of the pancreas. SCT is conducted to monitor the location of drains (see Fig. 6).

According to SCT with bolus introduction of contrast material, fragments of pancreatic parenchyma are visualized. The inflammatory process is extended to the front pararenal area and omental bursa.

Upon intravenous enhancement, fragmentary accumulation of contrast material in the areas of preserved pancreatic parenchyma is possible.
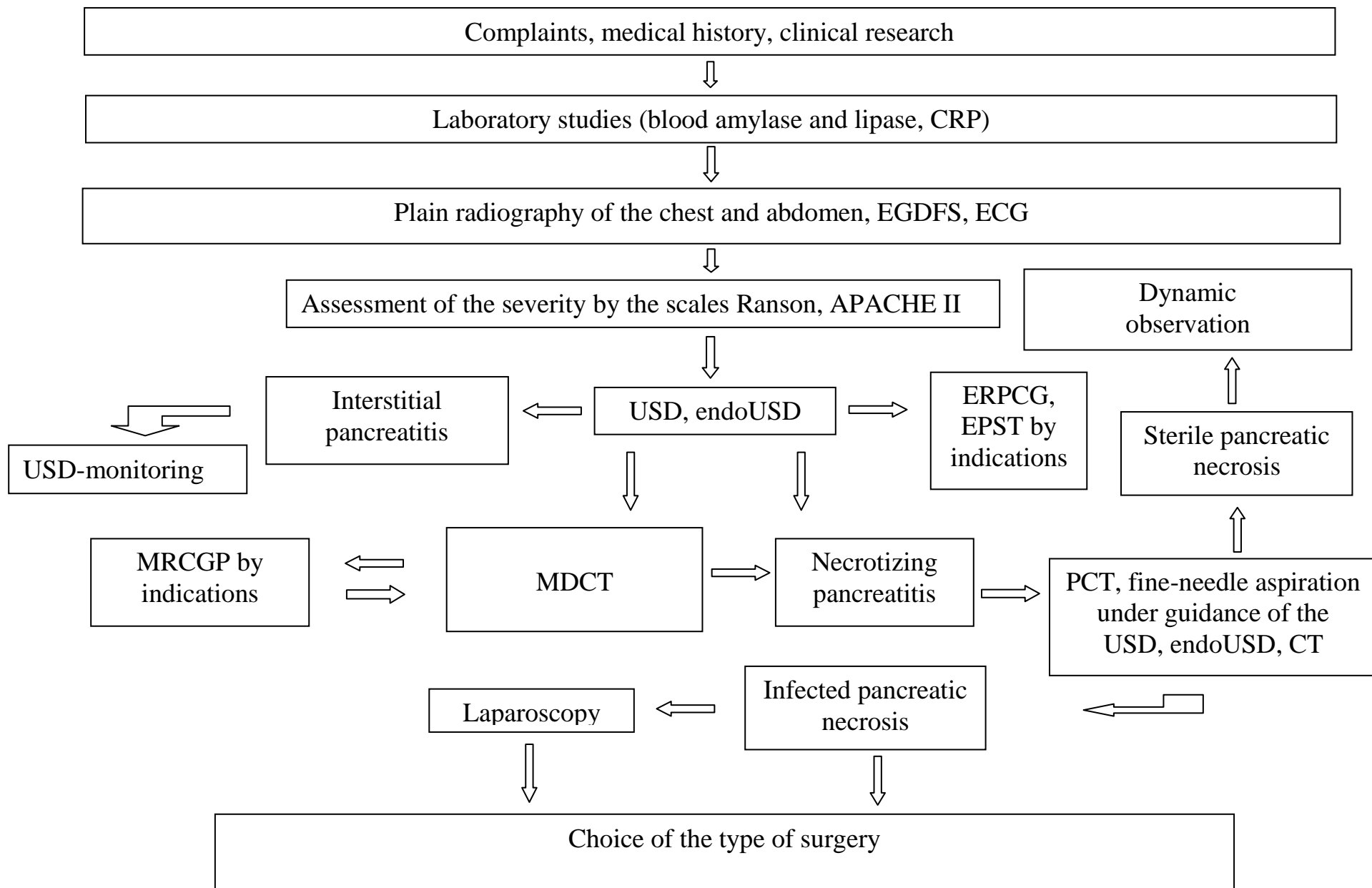
Thus, SKT is highly informative method of diagnosis of interstitial and necrotizing AP, differential diagnosis involves determining the changes of the pancreatic parenchyma and extrapancreatic changes. SCT-semiotics of the edematous pancreatitis is characterized by slight increase in the size of the pancreas, decrease in the density of the parenchyma, blurred contours of the organ, diffuse increase in density of the parapancreatic fiber. Semiotics of ANP is characterized by a significant increase in the size of the pancreas, diffuse decrease in the density of tissue, foci of significant reduction in the density, expressed extrapancreatic changes. According to indications, we carried MRCGP and MDCT with intravenous enhancement.

Laparoscopic study was performed using video endoscopic equipment. Laparoscopic set includes: video system with a camera and monitor, lighter, electronic insufflator, suction-irrigation system, electrocoagulator, surgical instruments. During endotracheal anesthesia, the anterior abdominal wall is pierced by trocar in the area of the Calc point, we injected laparoscope into the abdominal cavity through it. We consistently overlooked peritoneum, serous membrane of the stomach and intestine, greater omentum, pelvic organs. The main attention was paid to the number and nature of the effusion, the presence of foci of steatonecrosis, examination of the liver, gall bladder, hepatoduodenal ligaments. Upon intraperitoneal palpation by the tip of laparoscope, we determined liver consistency, degree of filling and the tone of the gall bladder wall, state of omental bursa and pancreas. During studying the localization and nature of effusion in the abdomen, we

evaluated the nature and spread of necrosis of the pancreas, overview of the posterior peritoneum allowed us to make a preliminary conclusion about the spread of necrotic tissue changes to the retroperitoneal space. Curative tasks of the laparoscopy were: removal of peritoneal fluid, decompression of the tissue of retroperitoneal space, sanitation and drainage of the abdominal cavity.

Thus, based on analysis of our studies, we designed and implemented in clinical practice the following diagnostic algorithm (Fig. 8).

Fig. 8. Diagnostic algorithm of AP.

Surgical treatment of ANP requires differential phased approach. ANP is seen as the phase disease. According to the phases, the stages of ANP surgery are described. We mark the following stages in which we performed such interventions.

Stage 1 — *enzyme phase of the disease* — diapeutic, laparoscopic sanitation, evacuation of the pancreatic ascites.

Stage 2 — *reactive phase of the disease* — percutaneous diapeutic and retroperitoneal video-guided, endoscopic surgery, rehabilitation and drainage of pathological foci of the pancreas, parapancreatic and retroperitoneal fiber.

Stage 3 — *phase of melting and sequestration* — percutaneous diapeutic and retroperitoneal video-guided, endoscopic, selective mini-invasive laparo- and lumbartomic surgery, "open" wide laparotomic surgery, relaparotomy.

Stage 4 — *phase of restitution* — diapeutic, endoscopic surgery, elective surgery of complications of ANP.

Conduction of the adequate and pathogenetically grounded treatment allowed us to interrupt the chain formation according to the stages of complications of ANP course, prevent further progression of severe manifestations of the disease.

Instead of active surgical tactics of treatment of ANP we proposed and implemented an active-waiting surgical tactics with dominating mini-invasive techniques as compared to wide "open" laparotomy. Compliance to such a surgical treatment, as shown by the survey data, greatly reduces the total and postoperative mortality, incidence of severe complications in this category of patients, which is suffering from ANP.

Mortality of patients in the study group was 6.72%, in the control group — 9.34%; incidence of complications in patients with ANP in the main group was reduced by 2.3 times; postoperative mortality of patients in the study group was 9.83%, in the control group — 13.28%.

Conclusions

1. Examination of patients by diagnostic algorithm developed by us revealed the correct and complete diagnosis in 93.8% of patients, and also allowed to choose the right tactics and strategy in the surgical treatment of ANP.

2. Individualized phased approach, respect for diagnostic and therapeutic algorithms by phases and variants of the disease can significantly improve the results of surgical treatment of ANP. Mortality of patients in the study group was 6.72% vs. 9.34% in the control group; complications in patients with ANP in the main study group were reduced by 2.3 times; postoperative mortality of patients in the study group was 9.83% as compared to 13.28% in retrospective study group.

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Based on the results of the research, new diagnostic algorithm was elaborated and implemented in clinical practice. Indispensable methods in the diagnostics of acute necrotizing pancreatitis are: determining blood amylase activity, C-reactive protein and computed tomography with intravenous contrast enhancement. Examination of patients, according to the developed diagnostic approaches, using clinical and instrumental methods, allowed to make a correct and full diagnostics in 93.8% of patients of the main group and to choose appropriate tactics and strategy for further differential staged surgical treatment of acute necrotizing pancreatitis. Mortality decreased from 9.34 to 6.72% in the main group; morbidity in patients with acute necrotizing pancreatitis in the main group decreased in 2,26 times; postoperative mortality decreased from 13.28 to 9.83%.