SPIRAL COMPUTED TOMOGRAPHY IN DIAGNOSTICS OF COMPLICATIONS OF ACUTE PANCREATITIS

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BACKGROUND	Early detection of pancreatic necrosis complications including purulent-septic ones largely predetermines the outcome of the treatment. In this article, we evaluated the role and capabilities of X-ray computed tomography in the diagnosis of acute pancreatitis complications.
OBJECTIVE	Studying the capabilities of spiral computed tomography (SCT) in the diagnosis of acute severe pancreatitis complications.
MATERIAL AND METHODS	Spiral CT results in 56 patients with severe acute pancreatitis and suspected infectious complications have been analyzed.
RESULTS	Revealed complications of the severe acute pancreatitis: circumscribed collection of fluid (32), abscesses of the omental bursa and retroperitoneal fat (18), retroperitoneal phlegmon (6). The semiotics of revealed complications has been described, and their relation with other organs and structures has been evaluated.
CONCLUSIONS	SCT conducted with contrasting techniques, reveals septic complications of severe acute pancreatitis, ascertains their form, location and amount, as well as the relation with other organs and structures helping identify the tactics of management, indications for surgery and assess its effectiveness.
Keywords:	severe acute pancreatitis, complications of pancreatitis, spiral computed tomography.

CT — computed tomography
SCT — spiral computed tomography

INTRODUCTION

Acute pancreatitis has been remained an urgent problem for decades, which is associated with the steady upward trend in the incidence and proportion of severe forms. The prevalence of pancreatic necrosis in Europe is 25—26.4 per 100,000 population [1, 2]. There is a more intense increase in the incidence reaching 27.4—50 cases per 100,000 population [3, 4] in Russia. Among all the complications of severe pancreatitis, infected necrosis is an unfavorable prognostic sign and has the most damaging effect [5]. Mortality in patients infected with pancreatic necrosis ranges from 40 to 80% according to various data [3, 4]. Among the survivors, disability occurs in 73% of cases, which attaches undeniable social importance to the issue, since the peak incidence occurs in people of working age from 30 to 50 years [6, 7].

Early detection of infectious complications of pancreatic necrosis largely predetermines the outcome of treatment in patients. The X-ray computed tomography (CT) may take the significant part in management of the challenge. According to various authors [1, 8, 9], timely results of CT are the basis of an objective assessment of the severity of acute pancreatitis, but the possibilities of this method in the diagnosis of complications of acute pancreatitis are still the subject of intensive study.

MATERIAL AND METHODS

The results of spiral computed tomography (SCT) in 56 patients with severe acute pancreatitis (24 patients with small focal necrotizing pancreatitis, 18 patients with macrofocal pancreatic necrosis and 14 patients with subtotal pancreatic necrosis) and suspected purulent complications treated at Sklifosovsky Research Institute for Emergency Medicine in 2009—2013 have been studied.

Most patients were men (39 men), average age — 44.8 ± 2.8 years (age variation of 18—79 years).

Studies were carried out at different times from the onset of the disease: 5 patients — within the first 24h, 11 patients — on days 2—3, 7 patients — on days 4—7, 33 cases — more than 7 days later (days 8—46).

All 56 patients underwent SCT of the abdomen and retroperitoneum, including SCT over time in 42 patients (98 studies in total).

Along with the scanning of the abdomen 3 patients underwent chest SCT, including the study over time (5 studies), one patient — chest and neck SCT.

All SCT studies were performed on spiral computed tomographs *CT/e* and *Zxi* of *«GE»* and *Aquilion Prime* (80x2) of *«Toshiba»*.

Almost all patients underwent preliminary preparation with the bowel contrasting before CT examination of the abdomen. For labeling all parts of the intestine, 2—3% solution of water-soluble iodinated contrast agent was used. Twenty milliliters of this water-soluble contrast agent (urografin, verografin, urotrast) were dissolved in 500 ml of water; the solution was taken twice — 12 hours and 3 hours prior to the study. If contrasting of the stomach and duodenum was necessary, a patient took 100—200 ml of a similar solution immediately before the study. SCT study was performed from the level of the cupula of diaphragm to the iliac crest, then, if there were changes spreading to the pelvic area, the study was continued in the caudal direction.

All studies were performed according to the standard program —layer collimation was 5 mm, reconstruction interval — 5 mm, the pitch of the helix — 1.5.

In the postoperative period, in order to identify undrained purulent collections and evaluate changes in inflammatory process of retroperitoneal fat, fistulography was conducted — filling the retroperitoneal cavities with a water-soluble contrast agent (76% Urografin) through the drain tubes.

The method of contrast bolus enhancement was used after the native study in order to improve the resolution of the CT.

An automatic injector was used for its performance, which was connected to the catheter of 18 or 20 *G* in diameter, set in the elbow or central vein. Then, iso-osmolar nonionic contrast agent was administered (concentration — 320 mg iodine/ml, volume — 100 ml, rate — 3 ml/sec). Scan delay averaged 30, 60 and 160 seconds. Preliminary analysis of SCT results was performed on a working console. The images obtained were subjected to qualitative (position, shape, dimensions, contours, texture, and density) and quantitative analysis (dimensions in mm, volume in cm^3, density in Hounsfield units). Then, postprocessing manipulation of images with the construction of multiplanar reformations was performed on a workstation.

SCT data were verified by the results of operations, autopsies and other clinical and hardware methods.

RESULTS AND DISCUSSION

Circumscribed collections of fluid (Fig. 1) were identified in 32 patients (49 cases). Non-compliance of the number of patients and studies occurred due to combination of two liquid accumulations of various localization in 11 patients and combination of 3 fluid accumulations of various localization in the other 3 patients.

According to the amount of pancreas destruction, patients with small focal pancreatic necrosis dominated in this group — 15 patients, 9 patients had macrofocal pancreatic necrosis and 8 patients had subtotal necrosis.

Circumscribed collections of fluid were visualized as areas with values of liquid density (18.4 ± 2.4 Hounsfield units), irregularly shaped, with sufficiently clear uneven contours (without visualization of the wall), of non-homogenious structure in 10 cases due to areas with densities of soft tissue (sequesters) located in the central parts. Most often, the liquid was revealed in the omental bursa (22 studies), in paracolic space on the left and right — 11 and 9 observations respectively, in the pararenal space on the left and right — 3 cases, and in the splenic hilum — one observation. The liquid volume ranged from 50 to 476 cm^3 (289.9 ± 10.2 cm^3 on the average). No areas of contrast agent accumulation within the liquid accumulations described above have been identified after intravenous administration of a contrast solution.

After SCT study, 28 patients underwent percutaneous drainage of fluid accumulations under ultrasound guidance with subsequent bacteriological analyzes of these contents, 4 patients underwent surgery (sanitation laparotomy, sequestrectomy, drainage of retroperitoneal space), also followed by bacteriological examination. Signs of infection of the collected contents were found in 14 patients, 18 patients had sterile contents. When comparing SCT semiotics of fluid accumulation in these 2 groups no distinctive CT signs were found.

In 18 patients, local purulent abscess in the form of abscesses of omental bursa and retroperitoneal fat was revealed (Fig. 2). According to the amount of pancreas destruction, patients with subtotal pancreatic necrosis dominated in this group — 10 cases, 8 patients had pancreatic macrofocal necrosis. In 8 patients, the abscess localized in the omental bursa, in 4 cases — in the head of pancreas, in 3 cases — at the splenic hilum, in 2 cases — in the paracolic space on the right and in one patient — in the subdiaphragmatic space.

Abscesses were visualized as zones with the values of density of fluid (18.2 ± 2.3 Hounsfield units), of irregular spherical shape, with unclear contours, and with inhomogeneous structure due to areas with density of soft tissues located peripherally (as a capsule of 4—7 mm thickness) and in two cases in the central sections (sequesters), with single areas of gas inclusions in 13 patients. After intravenous contrast enchancement, accumulation of the agent was observed in the peripheral areas that formed the wall of the visualized purulent cavities (capsule), preferably in the delayed phase. Visualization of a purulent cavity became clearer against infiltrative destructive changes of the retroperitoneal fat. Abscesses volume ranged from 55 to 610 cm^3 (196.2 ± 3.3 cm^3 on the average)

In all cases of omental bursa abscess the pathological process involved the stomach wall, deforming it and pushing the stomach anteriorly and upward. In the abscesses of retroperitoneal localization involvement of various organs depended on the location of the changed area: the vascular pedicle of the spleen and the walls of the descending colon were involved into pathological process in the pancreatic tail necrosis, and when changes preferentially occurred in the pancreatic head, the pathological process extended to the duodenum.

After SCT study all patients underwent percutaneous drainage of abscesses under the ultrosound guidance, which was failed in one case and followed by surgery (laparotomy, necrsequesterectomy**,** burso-omentostomy, sanitation and drainage of the abdominal cavity and retroperitoneal space), purulent contents were obtained.

Retroperitoneal phlegmon (Fig. 3) was diagnosed in 6 patients: with small-focal pancreatic necrosis in four patients and two — with macrofocal necrosis.

CT semiotics of the phlegmon of retroperitoneal space was characterized by extensive imaging area with values of density of the liquid in the retroperitoneal fat, of irregular shape, with indistinct contours and inhomogeneous structure due to areas with values of soft tissue located centrally (sequesters), and gas. In three patients, the disease process localized in paracolic and pararenal spaces on the left, in two patients —in paracolic and pararenal spaces on both sides and in one other patient — in paraduodenal and paracolic spaces on the right with the spread anteriorly on the gastrointestinal ligament and the mesentery of the small intestine. The involvement of other organs and tissues depended on the location of the area of changes.

After SCT all patients underwent surgery — laparotomy, necrsequesterectomy**,** drainage and tamponade of the retroperitoneal space.

In one patient, thrombophlebitis of the internal jugular vein (Fig. 4) and lung abscess (Fig. 5) were revealed along with the omental bursa abscess. During SCT study in this patient, the internal jugular vein was dilated, had indistinct contours and inhomogeneous structure due to low density areas (thrombotic masses), filling almost the entire lumen of the vein, with an accumulation defect at intravenous bolus contrast enhancement in the venous phase. Density of perivascular space fat was diffusely increased with the presence of focal and linear areas with the density of the soft tissue. Infiltrative changes of fatty tissue spread on the upper anterior mediastinum and soft tissues of the chest wall.

Lung abscess formation was visualized as a liquid with density values, of a round shape, with quite clear contours, non-gomogeneous structure due to the presence of areas with peripheral densities of soft tissue (capsules) and inclusions of gas above the liquid level. The abscess located in the III segment of the left lung, of 30 cm^3 volume.

In 42 patients, SCT was performed in over time in the postoperative period to assess the effectiveness of surgical treatment. There were 38 patients with positive changes (Fig. 6) as reduction of the amount and distribution of pathological changes. In four patients, despite performed drainage of retroperitoneal fat, further development of purulent process was observed in the postoperative period (Fig. 7), which was the

increase in the volume and range of changes and in the presence of liquid formations, not communicating with cavities contrasted at fistulography. Patients were re-operated, taking into account the data of SCT on undrained retroperitoneal abscesses.

FINDINGS

1. SCT study in patients with severe acute pancreatitis must be necessarily combined with contrast enhancement techniques in order to improve the accuracy of the method.

2. SCT allows to reveal infectious complications of severe acute pancreatitis, to ascertain their form, location and volume, as well as the relation with other organs and structures.

3. Inclusion of gas into the pathological areas with severe acute pancreatitis is a direct CT sign of purulence.

4. In order to identify undrained purulent formation and evaluate changes of inflammatory process in the retroperitoneal fat, the regular study should be complemented with fistulography.

5. SCT diagnosis of septic complications of pancreatic necrosis helps identify the tactics of management, indications for surgery and assess its effectiveness.

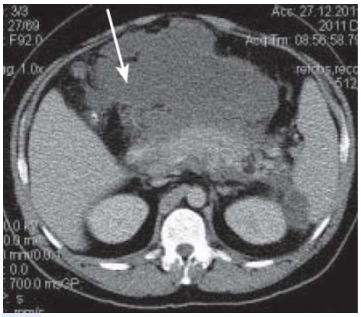


Fig. 1. Spiral computed tomography of the abdomen. Circumscribed fluid accumulation in the projection of omental bursa and gastro-colic ligament

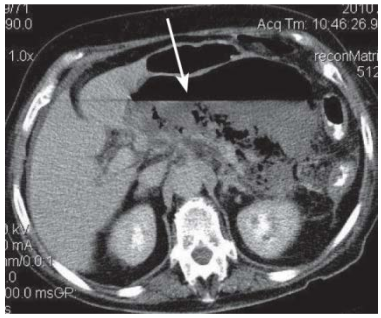


Fig. 2. Spiral computed tomography of the abdomen. Abscess of the omental bursa

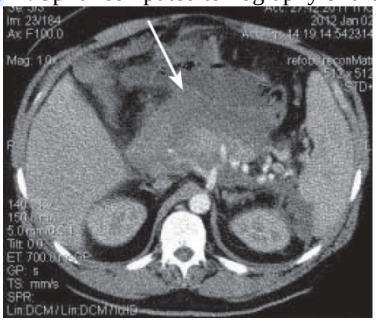


Fig. 3. Spiral computed tomography of the abdomen. Retroperitoneal phlegmon

Fig. 4. Spiral computed tomography of the neck. Thrombophlebitis of the internal jugular vein on the right side

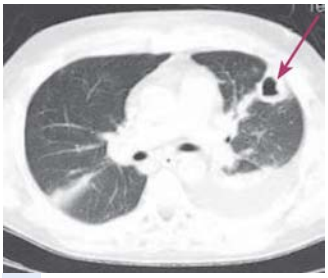
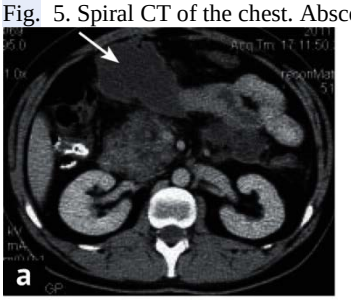


Fig. 5. Spiral CT of the chest. Abscess of the left lung



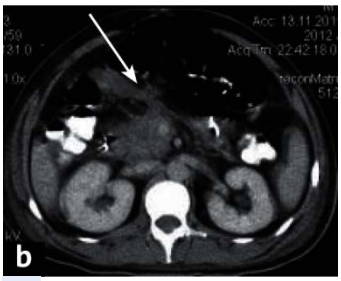
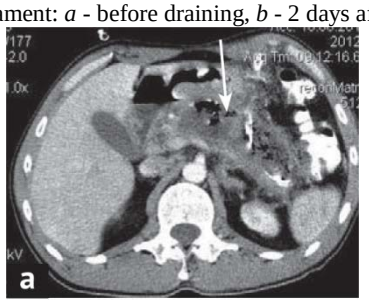


Fig. 6. Spiral computed tomography of the abdomen. Circumscribed fluid accumulation in the projection of omental bursa and gastro-colic ligament: *a* - before draining, *b* - 2 days after drainage (decrease in the volume of the liquid accumulation)



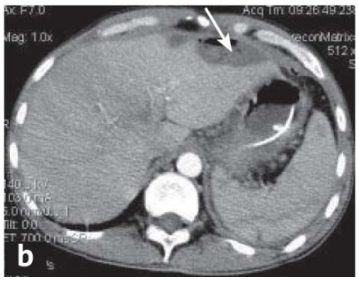


Fig. 7. Spiral computed tomography of the abdomen: *a* – drained abscess of the pancreatic body and omental bursa; *b* - undrained abscess of the subdiaphragmatic space

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