

General Reports

Chirurgia (2012) 107: 687-692
No. 6, November - December
Copyright © Celsius

The Role of Imaging Evidences in Pancreatic Suppurations

V. Strâmbu¹, M. Brătucu¹, P. Radu¹, C. Iorga¹, D. Garofil¹, A. Cuibac², F. Popa²

¹Department of General Surgery, "Carol Davila" Nephrology Clinical Hospital, Bucharest, Romania

²Department of General Surgery, "St. Pantelimon" Clinical Emergency Hospital, Bucharest, Romania

Rezumat

Rolul evidențelor imagistice în diagnosticul supurațiilor pancreatice

Autorii doresc să propună un protocol de interpretare a imagisticii dedicate supurațiilor pancreatice ce apar în pancreatita acută necrotico-hemoragică. Analizând datele din literatură privind modul de extensie al supurațiilor pancreatice, se avansează ideea conform căreia chirurgul trebuie el însuși să utilizeze și să interpreteze imagistica oferită. Folosindu-se de repere anatomice binecunoscute, evidențiabile pe imaginile și reconstrucțiile CT sau RMN, chirurgul este în măsură să aprecieze cât mai exact, pe bază de evidențe, raporturile și limitele colecțiilor supurative. Se obține astfel o hartă topografică cât mai precisă a zonelor supurative și se propune necesitatea de a ne raporta la spații retroperitoneale precis denumite, spații care fac parte din aria pararenală bilaterală. Astfel, se identifică repere anatomice lumenale, parenchimotoase și vasculare ce permit raportarea anatomică exactă a spațiilor retroperitoneale interesate de procesul patologic. Se creează astfel posibilitatea abordului chirurgical țintit, cu alegerea căilor de acces către zonele supurate în scopul evitării restanțelor și omisiunilor septice. Autorii propun în final raportarea imagistică la 13 arii retroperitoneale, arii care însumate sunt cuprinse sub denumirea de spațiu pararenal.

Cuvinte cheie: pancreatita acută supurată, supurație pancreatică, debridare, retroperitoneal, computer tomografie, reconstrucții coronale

Abstract

The authors wish to propose an interpretation protocol of the imaging dedicated to the pancreatic suppurations that appear in acute necrotising pancreatitis. Analyzing the data from the literature regarding the extension mode of the pancreatic suppurations, it promotes the idea according to which the surgeon must himself utilize and interpret the offered imaging. Using well known anatomical references, highlighted on the CT and MRI images and reconstructions, the surgeon is able to appreciate more accurately, on the basis of evidence, the references and limits of the suppurative collections. Thus, it is obtained a more precise topographic map of the suppurative areas and so it proposes the necessity of reporting to precisely named retroperitoneal spaces, that are part of the pararenal bilateral area. Hence it is identified the lumenal, parenchymal and vascular anatomical marks, which permit the exact anatomical reference of the retroperitoneal spaces interested by the pathological process. In this way, it creates the possibility of aimed surgical approach, with the selection of the ways of access towards the suppurative zones in order to avoid septic omissions. Finally, the authors propose the imaging reference to 13 retroperitoneal areas, areas that are contained under the name of pararenal space.

Corresponding author: Mircea Bratucu, M.D.
Department of General Surgery
"Carol Davila" Nephrology Clinical Hospital
Grivitei street, no. 4, sector 1, Bucharest
Romania
E-mail: bratucu_mircea@yahoo.com

Key words: acute necrotizing pancreatitis, pancreatic supuration, debridement, retroperitoneal, computed tomography, coronal reconstruction

Introduction

The seriousness of acute necrotic haemorrhagic pancreatitis (ANHP) is a well known fact. Its progressive evolution, whether fast or slow, towards necrosis and suppuration is also unanimously accepted as a fact, and is frequently unavoidable. Moreover, the treatment for ANHP is divided into two separate stages: the pre-surgical and the surgical stage. In the pre-surgical stage, pertaining to intensive care, the patient's evaluation is based on the Ranson, Apache II or Glasgow scores. It is the pre-suppurative stage, defined by the presence of uninfected necroses and haematomas. Therapy is based on maintaining vital functions. The second (surgical) stage, meant for treating infected necroses and suppurations per say, is based mainly on imaging criteria, dominated by the Balthasar score. (1)

In French medical literature, justly famous in the history of emergency surgery publications, the H. Mondor monography – “The Diagnosis of Abdominal Emergencies” (Masson Publishing House, 1937) bears the same flavour of text, enhanced by the clinically valuable and convincingly presented information. Credits should be given to a large group of renowned surgeons - Couvelaire, Dujarier, Gosset, Villard, Giordano, having each a personal experience limited to lots of 6 to 15 patients with ANHP. They succeeded however to define the existence of macroscopic lesions which impose the degree of gravity of this pathologic entity. Almost all insisted at the time that it is necessary to “reveal the entire pancreas along with its lodge openly, patiently and systematically” during the surgical act. Why is this broad approach necessary? So that no remaining necroses, haematomas or suppurated areas reveal themselves postoperatively. An interesting fact is that, by proceeding early with surgery, surgeons in those times rarely had records of suppurative pancreatitis. Rarely did the patient survive, in most cases death intervening after one or two weeks, before developing the suppurative process.

Nowadays matters have radically changed. Diagnoses are obtained rapidly, based on the known criteria and scores, supported by appropriate imaging. Only one aspect has remained the same – the anatomic pathology of the lesions and their distribution within the pancreas or surrounding it, as well as at a distance. Nothing has changed in this matter: the same haemorrhagic necroses, the same isolated, confluent or diffuse infected necroses, at different ages of development. The rate of complications, the biologic effects and the mortality rate are directly proportional with the degree and amplitude of the uninfected or septic necroses. (2,3)

Given these circumstances, a major objective has to be attained: the complete debridement, within the first surgical approach, of all devitalized, necrotic and/or septic areas. This all but not simple gesture is to be followed and completed by a close to exhaustive drainage of the pancreatic lodge and areas surrounding the pancreas which were involved in the pathologic process. In order to succeed in this venture a valuable imaging arsenal is at hand, with the help of which we are to establish with precision the extension areas of the necroses and suppurations.

The imaging resources should offer answers as precise as possible to what surgeons are looking for. To this purpose, the surgeon must know what type of imaging investigation to request, and what anatomical marks are to be searched by both himself and the imaging specialist. The anatomical marks are known, but they must also be used in establishing the surgical approach strategy. In order to be as exact as possible, information must be extracted out of the imaging “offers” (CT, MRI) based on the relations between the devitalized areas and the predetermined anatomical marks.

At the surgeon's request axial and coronal reconstructions must be done in order to appreciate sections in both the anterior-posterior (coronal) plane and in the sagittal plane. It is only thusly that we will obtain the precise topographical limits of the necrotic-suppurative lesions and we will be able to choose the type of surgical approach. Our purpose is that of reducing as much as possible the rate of suppurative remains. Incomplete drainage of necrotic foci represents an important cause of therapeutic failure, becoming the source for reintervention. In the surgical stage, imaging methods represent the “gold standard” in establishing the surgical approach.

Establishing the anatomical marks

There is a series of fixed, stabile marks which can and must be identified and used in determining from an imaging point of view the topographic retroperitoneal areas which are found in the proximity of the pancreatic area. The diffusion of necroses and suppurations is usually encountered towards these spaces. The imaging specialist and the surgeon have to, logically, relate to these marks in order to precisely localize the limits of the necrotic-suppurative foci. The majority of authors consider that the failure to drain the septic foci is responsible for a 100% mortality rate, and insufficient debridement is accompanied in 75% of the cases by death. (4,5,6,7)

At the moment, we have at our disposal two types of elective imaging methods in evaluating necroses and suppurative foci in acute severe pancreatitis (ASP): the CT exam with per oral and i.v. contrast, and the MRI. Their accuracy is comparable. (8) Contrast CT is recommended as a first choice investigation. In cases of intolerance to iodine agents or of renal disease, the CT scan will be replaced by an MRI.

It is desirable that the protocol of the CT scan be executed by means of a CT with multiple detectors (multi-detector spiral CT- MDCT), rapid scan equipment and vascular phase acquisition tools. (9)

The fact that programmes are already included in the CT equipment software ensures the acquisition of volumetric data, essential for performing coronal and sagittal multiplane reconstructions (1,10). MDCT can become an investigation even more sensitive through the minimum intensity prospective images of the multi-detector row CT technique. It offers the possibility to acquire a large number of images in a short period of time, facilitating post-processing techniques, with high resolution due to a thin line of collimation.

Similar results can be obtained as well by means of

contrast MRI techniques, using multi-plane sequences, 3D acquisitions, arterial and portal-venous phase acquisitions. Axial and coronal reconstruction with fat suppression makes the technique even more sensitive (11,12,13,14,15).

The anatomical marks at hand for determining the retroperitoneal spaces, which are the centre of septic necroses, are multiple: parenchymal, digestive lumens, vascular marks.

Parenchymal marks for native CT:

- the liver;
- the spleen;
- the kidneys;
- the pancreas.

Marks in oral contrast CT (digestive lumens):

- the gastric cavity;
- the duodenum frame;
- the duodenum-jejunum angle.

Vascular marks offered by i.v. contrast: (Fig. 1)

- the celiac trunk;
- the superior mesenteric axis;
- the renal pedicles;
- the aorta-cava plane (Fig. 2).

Based on these marks offered by oral and i.v. contrasts we will be able to determine the localizations and limits of the septic foci, under the absolute condition that we have at our disposal axial, coronal and sagittal reconstruction methods. (Fig. 3) We will thus be able to obtain spatial, 3D images. Therefore, the approach pathways and necrosis excisions will be as complete as possible. Why present this insistent plea for anatomical marks and imaging reconstruction? The reason is simple – in order for a surgical approach to be as complete as possible in draining suppurations, it requires more often the use of several access pathways in the pancreatic and surrounding areas, as well as at a distance (16,17). Unfortunately, the

majority of publications insist only on the approach through the omental bursa and evacuating collections thusly. It is an insufficient approach. The omental bursa is only a diverticulum, a dependency of the peritoneal cavity, therefore still an intraperitoneal space. To support this statement there are also arguments coming from the domain of anatomy. These are the retroperitoneal spaces and their compartments. The value of anatomical marks stands in the fact that we can determine which retroperitoneal spaces or compartments are involved in the necrotic-septic process. These retroperitoneal spaces are configured thusly:

- The right and left pre-renal sector;
- The right and left retro-renal sector;
- The left and right subdiaphragmatic sector;
- The right pancreatic sector (duodenal-pancreatic), located to the right from the aortic-mesenteric clamp;
- The left pancreatic sector (splenic-pancreatic) located to the left from the aortic-mesenteric clamp;
- The retro-pancreatic sector;
- The large vessels pre-vascular sector (aorta-cava plane);
- The left and right retro-colic sectors (Fig. 4);
- The pelvic sector.

An essential fact is that all these retro-peritoneal sectors communicate among each other, thus offering wide diffusion pathways for active enzymes to devitalize tissues through auto-digestion. Necrotic processes can spread from the diaphragm to the subperitoneal pelvic space. The presence of suppurative collections in one or more anatomical sectors is frequently recorded. (Fig. 5) In these extensive process situations, there are no limits separating the retroperitoneal sectors involved. Once entering a retroperitoneal abscess one discovers that it

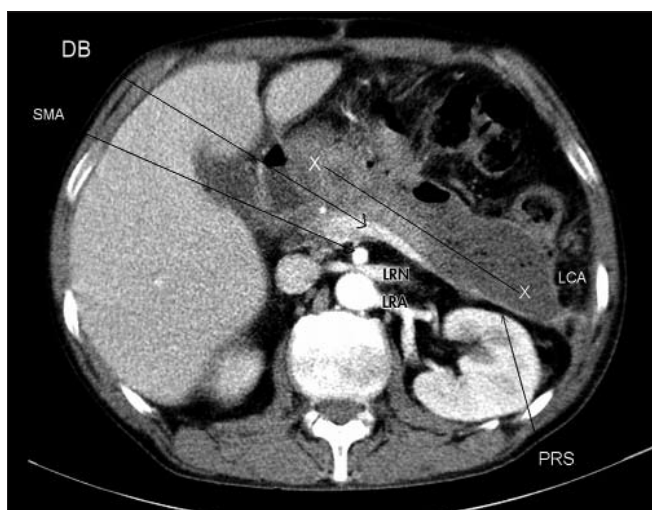


Figure 1. Contrast-enhanced CT scan- axial section. Large pancreatic phlegmon(X-X) in emphysematous pancreatitis. Gas filled cavities in pancreatic area; SMA- superior mesenteric artery; LRN- left renal vein; LRA- left renal artery; PRS- pararenal space; DB- duodenal border; LCA- left colic angle

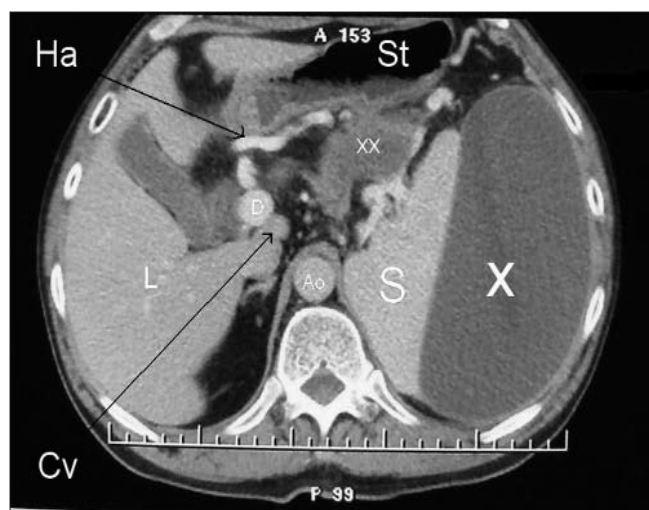


Figure 2. Axial section - CT contrast scan. Interspleno-phrenic abscess (X) related to the diaphragm, displacing medially the spleen (S); L-liver; Ao-aorta; XX - omental bursa abscess; St - stomach; D-duodenum; Cv - cava vein; Ha - hepatic artery



Figure 3. Contrast-enhanced CT scan sagittal section. Infected pancreatic necrosis plus omental bursa fat tissue abscess extended to anterior left pararenal space; St - stomach; X-X - collection; LK - atrophic left kidney; S - spleen; Ta - Treitz angle



Figure 4. CT scan axial section. Peripancreatic septic collections into the anterior right pararenal space and right retrocolic angle(X-X); RCA- right colic angle; CV- cava vein



Figure 5. Contrast-enhanced CT scan- coronal section. Multiple septic collections of fluid in the parapancreatic spaces; X - laterosplenic abscess; XX- preaortic collection; XXX - right prearenal and right retrocolic abscesses; S - spleen; St - stomach; CV- cava vein; SMA- superior mesenteric artery



Figure 6. Native CT scan- sagittal section. Infected necroses in Omental bursa and left pararenal space; X-X- collection; LK- left kidney; St- stomach; S- spleen

communicates with other abscessed areas, pertaining to other sectors. (Fig. 6) The suppuration can spread from the head to the tail, left to right and viceversa, being capable of invading

the entire retroperitoneal area, from the diaphragm to the floor formed by the Levator ani muscles, without any anatomical separation. It is in fact a suppuration of the lax retroperitoneal

tissue, more or less extensive. This retroperitoneal necrosis process can be compared, in great measure, to a “crush syndrome” or to a reperfusion syndrome after a prolonged reversible ischemia. A fact discovered in some of our patients is that, frequently, the necrosis of the pancreatic gland is less expressed, comparing to surrounding necrosis and suppurations, or to those at a distance. In other cases, the pancreas as a whole appears to be a necrotic slough, without other collections at a distance. There are no formation standards for necrosis. The rapid development of pancreatic necrosis will hamper the continuation of the “enzyme cascade”, which can be devastating both regionally and by means of its general effects. Plot disseminated necrotic-haemorrhagic “mosaic” pancreatic lesions in the gland, leaving parenchymal areas yet enzymatically active will allow the progression of retroperitoneal auto-digestion, with the involvement of sectors which are farther and farther away from the pancreas.

The imaging exploration will have to provide a definite opinion regarding the involvement of each of these sectors, in order to offer the surgeon a precise map of the areas requiring necrosis excision and drainage (18). The approach of the omental bursa is mandatory, but often insufficient. Not all the retroperitoneal compartments can be approached through the omental bursa.

Postoperative persistence of infected necrosis in any of these retroperitoneal sectors, in the majority of cases impossible to approach through the omental bursa, inevitably ensures the continuation of the sepsis, along with all its general effects. Open, closed, half-open abdomen surgical techniques or programmed reintervention have no chance of success if they are not based on precise imaging identification and treatment of debridement requiring areas.

Practical application of the imaging information

The death of retroperitoneal tissues due to ischemic aggression and auto-digestion is installed progressively, passing through several chronological stages. Tissue necrobiosis installed at the beginning of ANHP evolves towards full necrosis in 48-72 hours. The necrosis process is full, mature, at the end of this period of time. Another 10-14 days will be necessary after this to continue the evolution with superinfection, and afterwards with the formation of septic foci. Schematically, these stages can be presented thusly: once enabled the retroperitoneal enzyme attack, necrosis and haematomas appear in the first week, the necrosis is infected during the second week, and in the third week septic liquefaction of the necrosis takes place. All these moments have their clinical and imaging expression, which can be discovered through attentive evaluation.

Each stage is clearly defined based on clinical and imaging criteria. Necrobiosis and initial tissue suffering are expressed differently, as well as a mature necrosis will form in a different manner than a haematoma area, and completely different from a full suppuration. At this point one must mention that haematomas are always accompanied by necrosis, never isolated, in the absence of necrosis. We are in fact discussing about haemorrhagic necrosis.

From here we can draw the conclusion that it is necessary that, by means of imaging methods, accompanied by clinical information as well, to establish which devitalization stage has the patient reached and, secondly, which are the areas and limits of the necrotic-suppurative process. The answers to these questions are provided by CT and MRI scans, performed in the above described conditions.

Mature necrosis installation is certified by pancreatic or extrapancreatic areas, which do not capture contrast substances during the CT scan. The same information can be obtained from a contrast arterial phase MRI, sensitized by fat suppression – the necrosis does not capture the contrast substance, and hypo or hyper signal can be seen during the T1 and T2 sequences. Moreover, important relation data concerning biliary-pancreatic ductal systems can be obtained through cholangio-MRI. Basically, pre-contrast clichés are obtained, as well as parenchymal phase images, portal-venous time images, and late phase images. Thusly acquired information is valuable due to its precision with regards to the evolution stage of the necrosis. Once having established the age and stage of the necrosis, having confirmed the presence of septic collections, what remain to be described are the retroperitoneal spaces occupied by these, by making use of the anatomical marks described earlier.

Unfortunately, imaging report descriptions are often incomplete. They only partially refer to retroperitoneal anatomical spaces, determined by the previously mentioned marks. Most times we find information regarding the pancreas and juxta-pancreatic areas in the direct proximity of the gland. These frequent lacks of interpretation are corrected by clichés and records on digital support which offer a complete reconstruction image. The surgeon will find himself in front of an imprecise lesion map. This is also the reason for which it will be hard for him to precisely determine the limits of the retroperitoneal spaces which he must drain. Moreover, it is the source of the temptation to be satisfied with the only constant approach pathway – the omental bursa. Out of all these reasons, the surgeon will have to become familiar with the anatomical marks that delimit the retroperitoneal spaces. These are in fact the working tools which are referred to when establishing the approach areas, as well as the access pathways for each retroperitoneal space involved in the necrotic-suppurative process.

The adequate use of 3D reconstruction allows the precise visualization of all retroperitoneal sectors involved in suppurative processes. We are in fact referring to 13 sectors defined based on the anatomical marks that we suggested.

The surgeon will thus be able to precisely identify the relation between the collections and the anatomical structures highlighted by means of native and contrast imaging methods. Evidently, a right retro-renal collection cannot be drained through the omental bursa, despite of how much we would like to believe otherwise. Similarly, a left pre-renal suppuration and left retro-cholic suppuration cannot be approached through the omental bursa, even if we are to remove the peritoneum from all the retrogastric area.

Conclusions

1. Our desire was to present a new point of view with regards to the topographic diagnostic strategy in pancreatic suppuration, entirely based on imaging records.
2. We firmly believe that more than one surgeon has felt the need of a more precise anatomical description, based on imaging methods, of the topography of suppurative processes. Often however, the imaging methods offer is below our expectations.
3. We suggest, as a working method, the use of well-known anatomical marks, to which we can relate when establishing the topographic spaces involved in necrotic-suppurative processes.
4. It is obvious that it will be necessary to request sensitive and accurate imaging results, as complete as possible in terms of provided information, whose protocol includes exact references to the retroperitoneal spaces and marks which are of interest to the surgeon.
5. In order to avoid omissions (septic remains), the surgeon can make use of imaging methods. If provided with a 3D interpretation, this can offer the possibility of approaching the suppurative retroperitoneal sectors in their entirety. Exactly identifying which of the 13 sectors is involved in the septic process, we will have at our disposal an absolutely necessary mapping of the therapeutic strategy.
6. In the absence of a correct evaluation, on a 3D "topographic map" we risk to progress towards an insufficient surgical approach. Omissions, septic remains are the generators of unfavourable evolution and reintervention.

Acknowledgement

This paper is partly supported by the Sectorial Operational Programme Human Resources Development, financed from the European Social Fund and by the Romanian Government under the contract nr. POSDRU/88/1.5/S/64331

References

1. Balthazar EJ. Acute pancreatitis: assessment of severity with clinical and CT evaluation. *Radiology*. 2002;223(3):603-13.
2. Popescu I, Georgescu S. *Pancreatic and Peripancreatic Suppurations*. București: Editura medicală; 1990.
3. Popescu I. Management of acute severe pancreatitis. *Chirurgia (Bucur)*. 2006; 101(3):225-8. Romanian
4. Chooklin S, Perejaslov A. Management of purulent complications of severe acute pancreatitis. *Pancreatol*. 2002;2:217-361.
5. Bassi C, Falconi M, Sartori N, Bonora A, Caldiron E, Butturini G, et al. The role of surgery in the major early complications of severe acute pancreatitis. *Eur J Gastroenterol Hepatol*. 1997; 9(2):131-6.
6. Göttinger P, Wamser P, Exner R, Schwanzer E, Jakesz R, Függer R, et al. Surgical treatment of severe acute pancreatitis: timing of operation is crucial for survival. *Surg Infect (Larchmt)*. 2003; 4(2):205-11.
7. Renner IG, Savage WT 3rd, Pantoja JL, Renner VJ. Death due to acute pancreatitis. A retrospective analysis of 405 autopsy cases. *Dig Dis Sci*. 1985;30(10):1005-18.
8. Georgescu I, Nemes R, Cărtu D, Surlin V, Margaritescu D, Dumitrescu D, et al. Severe acute pancreatitis - diagnostic and therapeutic strategy. *Chirurgia (Bucur)*. 2005;100(6):557-62. Romanian
9. Nino-Murcia M, Jeffrey RB Jr, Beaulieu CF, Li KC, Rubin GD. Multidetector CT of the pancreas and bile duct system : value of curved planar reformations. *AJR Am J Roentgenol*. 2001;176(3): 689-93.
10. Maier W. Early objective diagnosis and staging of acute pancreatitis by contrast enhanced CT. In: Berger H, Buchler M, editors. *Acute pancreatitis*. Berlin: Springer-Verlag; 1987. p. 132-140.
11. Beuran M, Grigorescu M, Pascu O. *Actualități în Patologia Pancreatică*. Cluj-Napoca: Editura Medicală Universitară "Iuliu Hațieganu"; 2005.
12. Bolog N, Constantinescu G, Oancea I, Beuran M, Albu R, Tanta M, et al. Magnetic resonance imaging of bile and pancreatic ducts: a retrospective study. *Rom J Gastroenterol*. 2004;13(2):91-7.
13. Lecesne R, Taourel P, Bret PM, Atri M, Reinhold C. Acute pancreatitis: inter-observer agreement and correlation of CT and MR cholangiopancreatography with outcome. *Radiology*. 1999; 211(3):727-35.
14. Morgan DE, Baron TH, Smith JK, Robbin MI, Kenney PJ. Pancreatic fluid collections prior to intervention: evaluation with MR imaging compared with CT and US. *Radiology*. 1997;203(3):773-8.
15. Ward J, Chalmers AG, Guthrie AJ, Larvin M, Robinson PJ. T2-weighted and dynamic enhanced MRI in acute pancreatitis: comparison with contrast enhanced CT. *Clin Radiol*. 1997;52(2): 109-14.
16. Hajjar NA, Iancu C, Bodea R. *Modern Therapeutic Approach of Acute Severe Forms of Pancreatitis. A Review of the Literature and Experience of Surgical Department No III Cluj*. *Chirurgia (Bucur)*. 2012;107(5):605-10.
17. Botoi G, Andercou O, Andercou A, Marian D, Tamasan A, Span M. The management of acute pancreatitis according to the modern guidelines. *Chirurgia (Bucur)*. 2011;106(2):171-6. Romanian.
18. Cochior D, Constantinoiu S, Peța D, Birlă R, Pripși L, Hoară P. The importance of the timing of surgery in infected severe acute pancreatitis. *Chirurgia (Bucur)*. 2010;105(3):339-46. Romanian.