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Estimation of the Efficiency of Draining of the Abdominal Cavity in the Complicated Course of Acute Pancreatitis

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Abstract

Introduction. Acute pancreatitis is accompanied by a high risk of complications with about 70% mortality rate.
Purpose. To evaluate the effectiveness of paracentesis of abdominal cavity in treatment of patients with complicated acute pancreatitis.
Materials and methods. The treatment results of 60 patients with moderate and severe acute pancreatitis with the presence of exudate in the abdominal cavity were analyzed. The patients were divided into two groups (30 people each): a standard approach was used in treating the comparison group. Paracentesis of abdominal cavity was additionally performed at the first stage of treatment in the main group. There is no significant difference in patients of each group in age, sex, etiology and severity of the disease. The effectiveness of the treatment was assessed by studying laboratory blood parameters on the first day of detecting peritoneal fluid and after 72 hours. In addition, intra-abdominal pressure was determined for the patients. We also compared the incidence of infectious complications in the late phase of the disease and the length of hospital stay.
Results. A significant difference in intra-abdominal pressure and other indicators were revealed in patients in comparison group and the main group after 72 hours from the moment of detecting the liquid (17.4±2.6 and 11.4±1.6 mm Hg, $p<0.001$), serum amylase (774.3±233.9 and 472.7±168.6 U/L, $p<0.001$), procalcitonin (1.3±0.7 and 0.6±0.5 ng/mL, $p<0.001$) and interleukin-6 (531.3±120.9 and 417.1±82.4 pg/mL, $p<0.001$). Infectious complications developed in 50% of patients in the comparison group and 53.3% of patients in the main group ($p>0.05$).
Conclusions. Early use of paracentesis of the abdominal cavity at the first stage in the treatment of patients with acute pancreatitis with enzymatic peritonitis leads to a significant decrease in the level of intra-abdominal pressure by 31%, procalcitonin by 32%, interleukin-6 by 12% and amylase 27% ($p<0.001$).
Keywords: acute pancreatitis, paracentesis, infectious complications

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Оценка эффективности дренирования брюшной полости при осложненном течении острого панкреатита

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Резюме

Введение. Острый панкреатит сопровождается высоким риском развития осложнений, летальность при которых может достигать 70%.
Цель. Оценить эффективность парацентеза с дренированием брюшной полости в этапном лечении пациентов с осложненным течением острого панкреатита.
Материалы и методы. Были проанализированы результаты лечения 60 пациентов с острым панкреатитом средней тяжести и тяжелым течением с наличием экссудата в брюшной полости. Пациенты были распределены на две группы (по 30 человек): в группе сравнения применяли стандартный этапный подход в лечении, в основной группе на первом этапе лечения дополнительно осуществляли парацентез с дренированием брюшной полости. Пациенты обеих групп достоверно не отличались по возрасту, полу, этиологии и тяжести течения заболевания. Эффективность лечения оценивали путем изучения лабораторных показателей крови в день обнаружения перитонеальной жидкости и через 72 часа. Дополнительно пациентам определяли внутрибрюшное давление. Также сравнивали частоту инфекционных осложнений в позднем периоде заболевания и продолжительность пребывания в стационаре.
Результаты. Выявлена достоверная разница показателей внутрибрюшного давления у пациентов группы сравнения и основной группы через 72 часа с момента обнаружения жидкости (17,4±2,6 и 11,4±1,6 мм рт. ст., $p<0,001$), амилазы сыворотки крови (774,3±233,9 и 472,7±168,6 Ед/л, $p<0,001$), прокальцитонина (1,3±0,7 и 0,6±0,5 нг/мл, $p<0,001$) и интерлейкина-6 (531,3±120,9 и 417,1±82,4 пг/мл, $p<0,001$). В группе сравнения у 50% пациентов возникли инфекционные осложнения, а в основной группе – у 53,3% ($p>0,05$).
Выводы. Раннее применение парацентеза с дренированием брюшной полости как первого этапа в лечении пациентов с острым панкреатитом с ферментативным перитонитом ведет к достоверному снижению уровня внутрибрюшного давления на 31%, прокальцитонина – на 32%, интерлейкина-6 – на 12%, амилазы – на 27% ($p<0,001$).
Ключевые слова: острый панкреатит, парацентез, инфекционные осложнения

■ INTRODUCTION

Acute pancreatitis (AP) is a rapid progressive disease with a high risk of complications, with about 70% mortality rate [1]. At the regular congress of the International Association of Pancreatology which was held in 2011 in Cochin (India), and the International Working Group on Classification of AP (Acute Pancreatitis Classification Working Group) in 2012. The classification of AP was approved accordingly which distinguished the difference between interstitial edematous pancreatitis and necrotic pancreatitis. The severity of the disease is divided into three stages, pancreatic, peripancreatic and fluid accumulations (which occurs less than or more than 4 weeks after the onset of the disease) [2]. There are also two phases of AP accompanied by two peaks of mortality: The early phase (lasting during the first week) and the late phase (lasting several weeks and months).

According to literature, the local complications may occur in the early phase. They do not determine the severity of the patient's condition and may not be associated with the spread of necrosis during the first days of the disease [3]. In addition, it is noted that the severity of the morphological changes is not linearly dependent on the severity of organ failure, namely the determination of the severity of AP (moderate or severe) depends on the presence and duration of organ dysfunction [4]. Furthermore, the late phase is characterized by signs of systemic inflammation or local complications and is usually observed in patients with moderate and severe course (local complications occur during the second phase in most patients).

Currently, conservative methods are preferred (except for biliary pancreatitis) in the treatment of patients with AP in the early phase of the disease. This is due to the data taken according to the use of surgical treatment in the early stages of the disease which leads to an increase in complications, deaths and length of stay of patients in the hospital [5].

In addition, complications that appears in late phase of AP requires a step-up approach which is used in the surgical treatment of patients using mostly minimally invasive surgical interventions or their combination with video-assisted and open interventions. Thus, Freeny et al. (1998) first reported a new method of treatment, namely percutaneous drainage with a catheter under the control of computed tomography (CT) in infected acute necrotic pancreatitis. A positive result with the isolated use of this method was achieved in 47% of patients [6]. Also, according to literature, despite the fact that peripancreatic fluid accumulation and acute necrotic changes are most often detected in the period from 2 to 3 weeks of the disease, the use of percutaneous drainage is proposed not earlier than 4 weeks after the onset of AP [7].

There are studies on the treatment of peripancreatic fluid accumulations in the early period through the use of paracentesis of the abdominal cavity from the right or left iliac region at the present stage in the literature [8]. Indications for drainage at the presence of exudate in the abdominal cavity in amount more than 50 ml according to ultrasound examination or CT of the abdominal cavity. The demonstrated results indicate that early use of paracentesis of the abdominal cavity can effectively reduce the release of inflammatory factors and improve the clinical prognosis. However, it is not known whether the use of this treatment is associated with an increased risk of intra-abdominal infectious complications in patients with AP.

■ PURPOSE OF THE STUDY

To evaluate the effectiveness of paracentesis of the abdominal cavity in the treatment of patients with complicated acute pancreatitis.

MATERIALS AND METHODS

The study was conducted in the clinic of the Department of Surgery № 2 of Bogomolets National Medical University and was approved by the Commission in Bioethical Expertise and Ethics of Scientific Research (22.12.2016). All patients were examined from 2017 to 2021 and signed an informed consent to participate in this study and/or treatment at hospital. Criteria for inclusion in the study were: patients of both sexes over 18 years of age admitted to the hospital by ambulance with a diagnosis of AP lasting up to 7 days from the onset of the disease and the presence of exudate in the abdomen according to ultrasound examination or CT; the course is moderate and severe. The exclusion criteria were chronic somatic diseases in the decompensation phase, and the patient's refusal to participate in the study.

A prospective comparative study was conducted involving 60 people aged 31–71 years, who were divided into two groups: comparison group – patients who used a step-up approach in surgical treatment using endoscopic, open and minimally invasive surgery (n=30) and the main group – patients who were at the first stage of treatment, used paracentesis of the abdominal cavity from the left or right iliac region under local anesthesia (n=30). The diagnosis of AP was established in the presence of two of the following three criteria: 1 clinical (upper abdominal pain), 2 laboratory (serum amylase level three times higher than the upper limit of normal), 3 visual (CT, MRI, ultrasound examination). The study used the classification proposed by the International Working Group (Acute Pancreatitis Classification Working Group) in 2012. The severity of the course was determined using the APACHE II scale (severe course – more than 8 points). The diagnosis of moderate AP was established in the presence of transient multiorgan failure or local/systemic complications, severe – in the presence of persistent multiorgan failure (lasting more than 48 hours). Thus, AP of moderate severity was diagnosed in 14 patients (23.3%), and severe in 46 patients (76.7%). Re-assessment of the severity of the disease was performed on the day of detecting exudate in the abdominal cavity and after 72 hours from this time.

According to etiological factors, AP of alcoholic etiology occurred in 37 patients (61.7%), biliary etiology – in 21 patients (35%), idiopathic – in two patients (3.3%).

There is no significant difference in patients of each group in age (52.6±8.7 and 53.3±7.6 years, $p>0.05$ respectively), gender (men 53.3% and 60%, women 46.7% and 40%, $p>0.05$ respectively) and the etiology of the disease (alcoholic 60% and 63.3%, biliary 36.7% and 33.3%, idiopathic 3.3% and 3.3%, $p>0.05$ respectively). There was also no significant difference between the indicators (sum of points according to the APACHE II scale) of the severity of the disease of the comparison group and the main group at the time of hospitalization (11.3±4.6 and 11.4±4.3, $p>0.05$ respectively).

All patients received conservative therapy and surgical treatment according to the indications (with prior paracentesis of the abdominal cavity or without this procedure) in accordance with the instructions of the State Expert Center of the Ministry of Health of Ukraine "Adapted evidence-based clinical guidelines", edited by Komarov et al. (2016) [9].

To compare the course of the inflammatory process, blood was taken on the day of detecting fluid in the abdominal cavity and after 72 hours. The following specific laboratory blood parameters were determined: Amylase, Leukocytes, C-reactive protein, Procalcitonin and Interleukin-6. Additionally, patients were assessed for intra-abdominal pressure (IAP) by an indirect method, by measuring bladder pressure (Kron, 1984). We also

compared the incidence of intra-abdominal infectious complications in the late phase of the disease and the length of stay of patients in the hospital.

Statistics

The normality of data distribution was determined by the Shapiro – Wilk test. The difference between the groups was determined using Student's t test for independent samples in the case of parametric and Kruskal – Wallis test in the case of nonparametric data distribution. Differences in the sample distribution were assessed using the χ^2 test criterion. Differences in the dynamics of the group were determined using Student's t test for related samples. The results are presented as mean values and their standard deviation (M±SD) in the parametric or as the median and quartile (Me [Q1–Q3]) in the nonparametric distribution. Differences between indicators were considered significant at $p<0.05$.

Statistical analysis were performed using Statistical 10 (Serial Number: STA999K347150-W) and MEDCALC® (open access Internet resource, https://www.medcalc.org/calc/).

■ RESULTS

Acute peripancreatic fluid accumulations, namely exudate in the abdominal cavity were detected in patients of the comparison group at 9.1±0.9 days, and the main group – 8.7±1.2 days ($p>0.05$) when comparing the laboratory parameters of the systemic inflammatory response at the time of detecting fluid in the abdominal cavity between the comparison group and the main group. Significant difference was not found (Table 1).

When comparing IAP in patients of the comparison group and the main group, at the time of detecting fluid; no significant difference was found (16.5±2.9 and 16.6±2.5 mm Hg, $p>0.05$ respectively). The sum of scores on the APACHE II scale at the time of exudate in

Table 1
Laboratory indicators of systemic inflammatory response in patients with acute pancreatitis at the time of detecting of fluid in the abdominal cavity

Indexes	Rate	Comparison group (n=30)	Main group (n=30)	p
Blood Leukocytes	$4–9\times10^9$	12.6±2.3	12.5±2	0.882
Serum Amylase	25–115 U/L	646.7±226.9	649.3±264.4	0.966
C-reactive protein	0.8–8 mg/L	144.6±60.7	140.5±55.3	0.783
Procalcitonin	0–0.046 ng/mL	0.8±0.5	0.9±0.6	0.853
Interleukin-6	<7 pg/mL	468.8±95.9	472.7±50.3	0.875

Table 2
Laboratory indicators of systemic inflammatory response in patients with acute pancreatitis after 72 hours from the moment of detecting fluid in the abdominal cavity

Indexes	Rate	Comparison group (n=30)	Main group (n=30)	p
Blood Leukocytes	$4–9\times10^9$	12.7±1.6	12.5±0.9	0.925
Serum Amylase	25–115 U/L	774.3±233.9	472.7±168.6	<0.001
C-reactive protein	0.8–8 mg/L	165.3±62.1	159.1±43.4	0.652
Procalcitonin	0–0.046 ng/mL	1.3±0.7	0.6±0.5	<0.001
Interleukin-6	<7 pg/mL	531.3±120.9	417.1±82.4	<0.001

the abdomen in comparison group – 12.5±5.9 and the main group – 12.9±5.9 (p>0.05 respectively).

When analyzing the indicators of systemic inflammatory response after 72 hours of detecting exudate in the abdominal cavity, a significant difference was obtained between laboratory parameters of Procalcitonin (Fig. 1), Interleukin-6 (Fig. 2), Serum amylase (Fig. 3) of the comparison group and the main group (Table 2).

There was also a significant difference in IAP in patients of the comparison group and the main group after 72 hours from the moment of fluid detection (17.4±2.6 and 11.4±1.6 mm Hg, p<0.001 respectively). The sum of points on the APACHE II scale after 72 hours from the moment of appearance of exudate in the abdominal cavity in the main group was less than in the comparison group, but did not differ significantly (11.7±5.3 and 12.6±4.2, p>0.05 respectively).

According to the results of the study, it was found that the use of paracentesis of the abdominal cavity in the early period contributes to a probable reduction in IAP by 31% (p<0.001) after 72 hours from the moment of detecting fluid in the abdominal cavity and such indicators of systemic inflammatory response as Procalcitonin by 32% (p<0.001), Interleukin-6 by 12% (p<0.0001) and Serum Amylase by 27% (p<0.001), in relation to the comparison group.

At the next stage of the study, the analysis of the frequency of intra-abdominal infectious complications in the comparison group and the main group (50% and 53.3%,

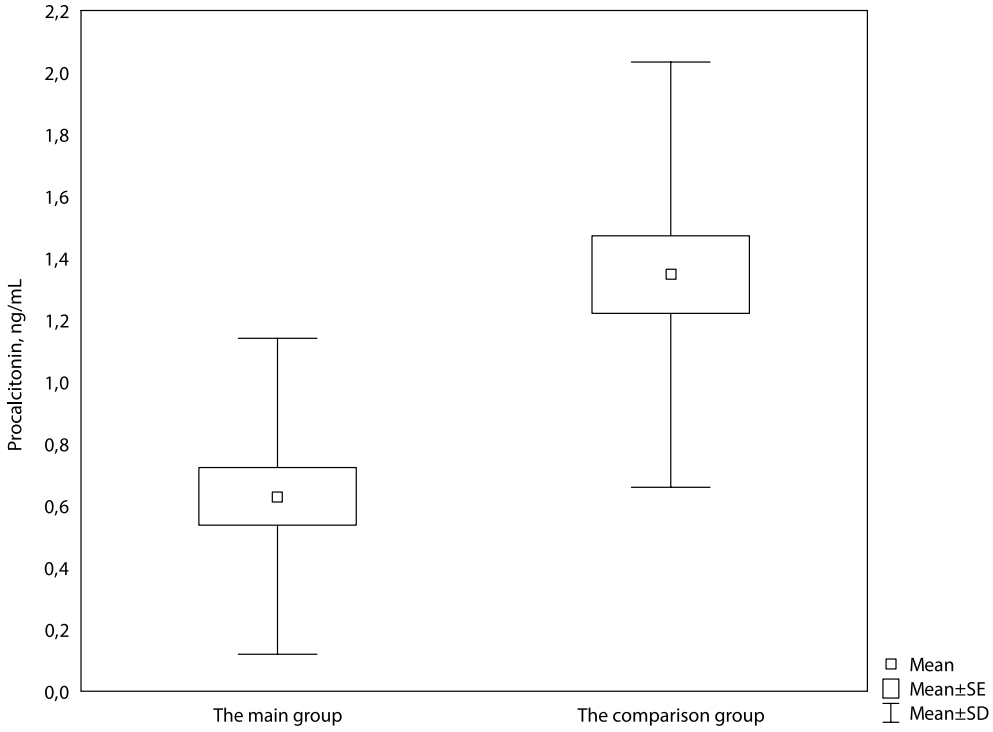

Fig. 1. Levels of Procalcitonin after 72 hours from the moment of detecting fluid in the abdominal cavity

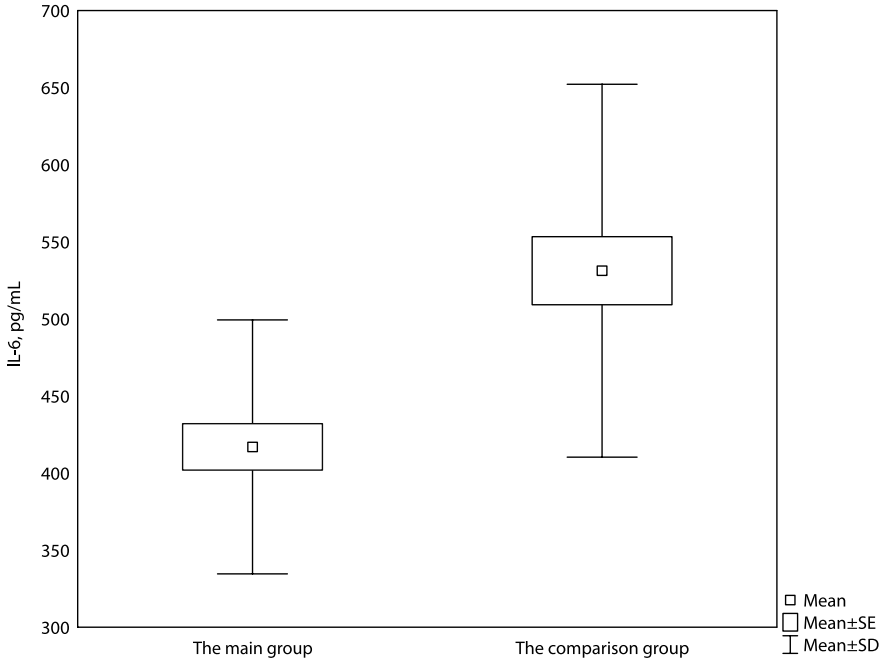

Fig. 2. Levels of Interleukin-6 after 72 hours from the moment of detecting fluid in the abdominal cavity

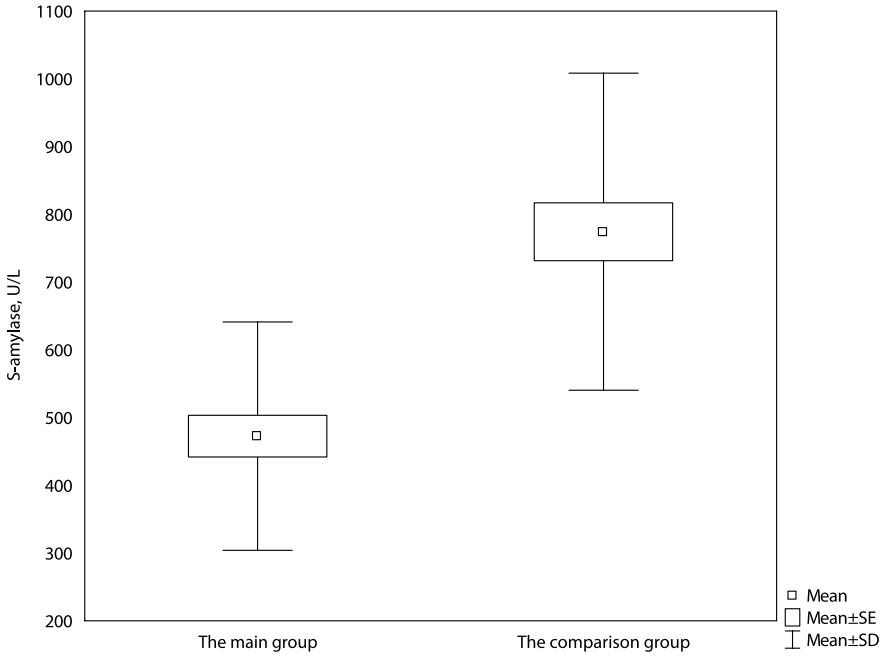

Fig. 3. Serum Amylase levels after 72 hours from the moment of detecting fluid in the abdominal cavity

p>0.05 respectively) was performed. Thus, these complications occurred in 15 patients (50%) in the comparison group: in 11 patients (36.7%) – acute infected necrotic collection, in 4 patients (13.3%) – infected walled-off necrosis. In the main group, the development of intra-abdominal infectious complications was diagnosed in 16 patients (53.3%): in 9 patients (30%) acute infected necrotic collection, in 4 patients (13.3%) – infected walled-off necrosis and in 3 patients (10%) infected pancreatic pseudocyst. The mortality rate in the main group and in the comparison group was 3.3% (one patient from each group). These were elderly patients whose condition worsened with the progression of the disease and the development of erosive bleeding. The immediate causes of their deaths were acute cardiovascular, respiratory and hepato-renal failure.

The length of stay of patients in the hospital was shorter in the main group and amounted to 69.1 [29.0–124.0] days, while in the comparison group – 96.3 [36.0–118.0] days (p>0.05).

■ DISCUSSION

According to literature, acute peripancreatic fluid collection occurs in 40% of patients with AP and in 50% of cases they disappear spontaneously, and do not require surgical treatment [10]. However, the translocation of the intestinal microflora and the occurrence of secondary infection in necrotic tissues and fluid formations are possible in the late phase of the disease in patients of this category due to the violation of the intestinal barrier [11]. As mentioned above, at present, when choosing a method of surgical interventions for purulent complications of AP, preference is given to the step-up approach treatment with minimally invasive echo-controlled interventions, namely percutaneous drainage under ultrasound control, followed by necrectomy if necessary. However, in the case of infected necrotic accumulation in combination with exudate in the abdominal cavity, this approach may not be optimal and will need to be improved. Therefore, the treatment of complications of AP, which are also accompanied by the presence of fluid in the abdomen and pelvic cavity remains the subject of much debate.

In our study, we aimed to determine the safety and feasibility of paracentesis of the abdominal cavity at the first stage in the treatment of patients with AP, the course of which is complicated by the presence of fluid in the abdominal cavity. In the modern literature, there are studies where the authors emphasize that the removal of exudate from the abdominal cavity in AP leads to a decrease in the systemic inflammatory response, reducing the severity of the disease [12]. In our study, we also obtained a decrease in Procalcitonin from 0.9±0.6 ng/mL to 0.6±0.5 ng/mL (p<0.001), Interleukin-6 from 472.7±66.6 pg/mL to 417.1±82.4 pg/mL (p<0.001) and Serum Amylase levels from 649.3±264.4 U/L to 472.7±168.6 U/L (p<0.001) when the use of paracentesis of the abdominal cavity in the first stage of treatment of patients with AP, the course of which was complicated by the presence of fluid in the abdominal cavity in contrast to the comparison group, where these indicators are likely to increase. This trend is also observed with IAP values (from 16.6±2.5 mm Hg to 11.4±1.6 mm Hg, p<0.001). There was no significant difference between blood leukocytes and C-reactive protein between the comparison group and the main group and the severity of the disease according to the APACHE II scale.

There is also controversy that early paracentesis of the abdominal cavity may increase the incidence of late-onset complications due to infection of pancreatic and peripancreatic fluid collection, which is the leading cause of death in patients with AP [13]. In our study,

we did not find a significant difference between the increase in the incidence of infectious complications in the main group compared to the comparison group (53.3% and 50%, p>0.05 respectively) and fatalities (3.3% and 3.3%, p>0.05 respectively). However, there was a tendency to reduce the length of hospital stay of patients in the main group compared to the comparison group (69.1±20.9 days vs. 96.3±17.4 days, p>0.05 respectively). We agree that abdominal drainage can lead to colonization of microorganisms and secondary infection [14], but it should be noted that in the late phase of AP patients are also at high risk of translocation of intestinal microflora and infection of pancreatic pseudocyst, walled-off necrosis, fluid collection. Finally, the study of infected content in this case is not possible. Thus, patients with severe and moderate AP are at risk regardless of the presence or absence of abdominal drainage, and the content can be analyzed to determine the nature of the microflora and determine its sensitivity to antibiotics in case of infectious complications.

■ CONCLUSIONS

1. Early use of paracentesis of the abdominal cavity as first stage treatment of patients with acute pancreatitis complicated by enzymatic peritonitis leads to a significant reduction in systemic inflammatory response (Procalcitonin, Interleukin-6), Serum Amylase and intra-abdominal pressure (p<0.001).
2. At the same time, no significant difference in the incidence of infectious complications with the additional use of paracentesis of the abdominal cavity in this category of patients in relation to the comparison group.
3. There is the tendency to reduce the bed-day stay of patients in the hospital from 96.3±17.4 days to 69.1±20.9 days (p>0.05). Hence to reduce the cost of treatment with the use of paracentesis of the abdominal cavity in the step-up approach treatment of patients with complicated acute pancreatitis.

■ REFERENCES

1. Wu D, Ding J, Jia Y, Liu H, Xiao J, Peng J. Predictors of mortality in acute pancreatitis complicated with multidrug-resistant Klebsiella pneumoniae infection. *BMC Infect Dis.* 2021 Sep 20;21(1):977. doi: 10.1186/s12879-021-06709-0.
2. Foster BR, Jensen KK, Bakis G, Shaaban AM, Coakley FV. Revised Atlanta Classification for Acute Pancreatitis: A Pictorial Essay. *Radiographics.* 2016 May – Jun;36(3):675–87. doi: 10.1148/rg.2016150097. Erratum in: *Radiographics.* 2019 May – Jun;39(3):912.
3. Portelli M, Jones CD. Severe acute pancreatitis: pathogenesis, diagnosis and surgical management. *Hepatobiliary Pancreat Dis Int.* 2017 Apr;16(2):155–159. doi: 10.1016/s1499-3872(16)60163-7.
4. Leppäniemi A, Tolonen M, Tarasconi A, Segovia-Lohse H, Gamberini E, Kirkpatrick AW, Ball CG, Parry N, Sartelli M, Wolbrink D, vanGoor H, Baiocchi G, Ansaloni L, Biffl W, Coccolini F, DiSaverio S, Kluger Y, Moore E, Catena F. 2019 WSES guidelines for the management of severe acute pancreatitis. *World J EmergSurg.* 2019 Jun 13;14:27. doi: 10.1186/s13017-019-0247-0.
5. Boxhoorn L, Voermans RP, Bouwense SA, Bruno MJ, Verdonk RC, Boermeester MA, van Santvoort HC, Besselink MG. Acute pancreatitis. *Lancet.* 2020 Sep 5;396(10252):726–734. doi: 10.1016/S0140-6736(20)31310-6. Erratum in: *Lancet.* 2021 Nov 6;398(10312):1686.
6. Freeny PC, Hauptmann E, Althaus SJ, Traverso LW, Sinanan M. Percutaneous CT-guided catheter drainage of infected acute necrotizing pancreatitis: techniques and results. *AJR Am J Roentgenol.* 1998 Apr;170(4):969–75. doi: 10.2214/ajr.170.4.9530046.
7. van Grinsven J, van Santvoort HC, Boermeester MA, Dejong CH, van Eijck CH, Fockens P, Besselink MG; Dutch Pancreatitis Study Group. Timing of catheter drainage in infected necrotizing pancreatitis. *Nat Rev Gastroenterol Hepatol.* 2016 May;13(5):306–12. doi: 10.1038/nrgastro.2016.23.
8. Lu Z, Zhu X, Hua T, Zhang J, Xiao W, Jia D, Yang M. Efficacy and safety of abdominal paracentesis drainage on patients with acute pancreatitis: a systematic review and meta-analysis. *BMJ Open.* 2021 Aug 9;11(8):e045031. doi: 10.1136/bmjopen-2020-045031.
9. Komarov MP. *Acute pancreatitis [Text]. Adapted evidence-based clinical setting.* Kyiv: State Expert Center of the Ministry of Health of Ukraine. 2016: 53 s. (in Ukrainian)
10. Acute Pancreatitis and Fluid-Filled Collections: Etiology and Endoscopic Management. *Gastroenterol Nurs.* 2019 Sep/Oct;42(5):E1–E2. doi: 10.1097/SGA.0000000000000494.
11. Husu HL, Valkonen MM, Leppäniemi AK, Mentula PJ. Occurrence and Risk Factors of Infected Pancreatic Necrosis in Intensive Care Unit-Treated Patients with Necrotizing Severe Acute Pancreatitis. *J Gastrointest Surg.* 2021 Sep;25(9):2289–2298. doi: 10.1007/s11605-021-05033-x.
12. Liu WH, Wang T, Yan HT, Chen T, Xu C, Ye P, Zhang N, Liu ZC, Tang LJ. Predictors of percutaneous catheter drainage (PCD) after abdominal paracentesis drainage (APD) in patients with moderately severe or severe acute pancreatitis along with fluid collections. *PLoSOne.* 2015 Feb 6;10(2):e0115348. doi: 10.1371/journal.pone.0115348.
13. Mourad MM, Evans R, Kalidindi V, Navaratnam R, Dvorkin L, Bramhall SR. Prophylactic antibiotics in acute pancreatitis: endless debate. *Ann R Coll Surg Engl.* 2017 Feb;99(2):107–112. doi: 10.1308/rcsann.2016.0355.
14. Hüttner FJ, Probst P, Knebel P, Strobel O, Hackert T, Ulrich A, Büchler MW, Diener MK. Meta-analysis of prophylactic abdominal drainage in pancreatic surgery. *Br J Surg.* 2017 May;104(6):660–668. doi: 10.1002/bjs.10505.