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Characteristics of leukocyte profile of blood and criteria sirs in patients with abdominal sepsis

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Abstract
Results of surgical treatment of 284 patients with acute appendicitis, cholecystitis, infected pancreatic necrosis and perforation of the stomach ulcer or duodenal ulcer were analyzed. All patients were divided into two groups: I - 100 patients with abdominal sepsis (35.2%) and II - 184 - without it. The study found that abdominal sepsis developed significantly more often in elderly and senile patients ($p < 0.05$). Postoperative complications and mortality are significantly more frequently encountered in patients with AS, respectively, 8.6% versus 2.8% ($p < 0.05$) and 10% versus 1.6% ($p < 0.05$). Abdominal sepsis resulted in a high level of LII and reduction of the absolute number of lymphocytes, which can be considered an objective evidence of potentiated endogenous intoxication and immunosuppression.

Keywords: acute abdominal surgical pathology, abdominal sepsis, the criteria for SIRS, leukocyte profile.

1. Introduction
Despite the apparent success in improvement of diseases diagnosis and treatment methods, abdominal sepsis (AS) continues to hold first place in the structure of causes of death of the patients in intensive care and surgery, causing high rates of mortality [1, 2, 11]. Sepsis is a complex, multifactorial syndrome that can manifest itself in conditions of varying severity. Not diagnosed in time, the AS mostly leads to organ failure and death [1]. Early diagnosis of severe sepsis is an extremely important means of reducing mortality caused by multiple organ dysfunction syndrome [2]. Identification and control of the source of infection is the first step in the treatment of intra-abdominal infections and AS. Delays in surgery or insufficient control of AS source, especially in case of severe sepsis, can lead to undesirable consequences of treatment [3]. However, not every case of acute surgical diseases of the abdominal cavity is complicated by the AS. An essential condition for the development of sepsis is suppression of the immune system of the patient which creates opportunities for the dissemination of pathogens and their toxins and release of inflammatory mediators in the body, causing systemic response [6]. Identification of the number of leukocytes and platelets in peripheral blood, erythrocyte sedimentation rate, procalcitonin content, C-reactive protein and lactate in the patients with AS primarily reflects the presence and severity of infection rather than the state of the body's defenses. [4] Several studies have been devoted to highly informative search criteria of dysfunction of the immune system in patients with AS and its possible correction [4, 9, 12, 13, 14, 15, 19], but until now the results are not sufficiently taken into account in clinical protocols for diagnosis and treatment of this severe, life-threatening pathology.
The objective of the research is to analyze the structure and course of acute surgical diseases of the abdominal cavity complicated by sepsis, identify the features of leukocyte blood profile and criteria of SIRS.

2. Material and methods
The study retrospectively analyzed the results of the treatment of 284 patients with acute surgical abdominal pathology operated in the second surgical department of the Lviv Regional Hospital in 2010-2013. The age of patients was within 18-88 years (average - 50,1 ± 1,2). Male patients slightly dominated - 159 (55.9%). All patients were hospitalized according to the urgent procedure, on average on the 4,3th ± 0,5 day after the first manifestations of the disease. With general clinical (analysis of complaints and disease history, physical examination), laboratory (complete blood count and urinalysis, blood chemistry), instrumental (videolaroscopic examination) and radiation (ultrasound, radiography of the abdomen, CT) methods, 111 patients (39.1%) were diagnosed with acute cholecystitis, 70 (24.6%) – with acute appendicitis 69 (24.3%) – with acute pancreatitis, 34 patients (11.9%) - with perforation of gastric or duodenal ulcer.

According to the objectives of the study, all the patients were divided into two groups: the first (I), with the signs of the AS, and the second (II) where these signs were absent. The diagnosis of AS was stated in case of the presence of acute infectious inflammation of the abdominal cavity and at least two criteria SIRS [17]. The manifestation of multiple organ dysfunction syndrome in patients with AS marked the emergence of severe sepsis and ongoing hypotension despite the intensive infusion therapy and use of vasopressors - septic shock. The second group consisted of 184 patients (64.8%).
The first group included 100 patients (35.2%): 30 (43.5%) - with acute pancreatitis, 13 (38.2%) – with perforation of gastric or duodenal ulcer, 35 (31.5 %) - acute cholecystitis, - 22 (31.4%) - acute appendicitis. Local peritonitis was found in 48 patients (48%), including 30 (62.5%) with acute cholecystitis and 18 (37.5%) with acute appendicitis. Diffuse peritonitis was stated in 22 (22%) patients, including 13 (59.1%) of perforation gastric or duodenal ulcer, 5 (22.7%) - acute cholecystitis, 4 (18.2%) - acute appendicitis. Infected necrotizing pancreatitis was diagnosed in 30 (43.5%) patients.

The presence of the AS stated in 77 patients (77%); in 23 (23%) - severe sepsis, evidence of which was a combination of renal and hepatic failure with cardiovascular one. Septic shock was not detected in any of the patients. SIRS criteria analysis showed the following features: fever (> 38 °C) was observed in 54 patients (54%), tachycardia (> 90 beats / min) – in 80 (80%), tachypnea (> 20 / min) – in 40 (40%), leukocytosis (≥12 thousand / mm³) - in 94 patients (94%). The presence of two SIRS criteria found in 69 (69%) patients, three - in 28 (28%), four - only in 3 (3%). Thus, in patients with AS, two figures of the criteria SIRS dominated (leukocytosis and tachycardia) and their frequency varied from 53.9% to 77.3% (average - 65,6 ± 9,8%).
Microbiological analysis of blood cultures in patients with AS showed pathogens in the blood - in 5% of cases, peritoneal fluid - in 95.4% of cases. Pathogenic organisms have been presented in monoinfection 28.4% of cases (Gram (+) - 5,9%, Gram (-) - 22.5%), associations of microorganisms - at 71.6%. With peritoneal exudate often plated *E. coli*, *Ps. aeruginosa*, *S. aureus*.
Total average stay in the hospital was 14,7 ± 1,0 days. Only 13 patients died (postoperative mortality - 4.5%). The main cause of death was recognized single and multiple organ failure.
In order to estimate the expected endogenous intoxication, leukocyte index of intoxication (LII) was calculated [5]. The first level of the assessment of lymphocyte-dependent immune mechanisms assessed by the absolute and relative number of lymphocytes in the peripheral blood [9]. Particular attention was paid to the absolute lymphopenia (<1.4 g/l), since the relative lymphopenia (<18%) is often offset by leukocytosis.
Statistical processing of the results was done using the programs Microsoft Office Excel and Statistica. A variation-statistical analysis of relative and average values carried out. In-depth analysis of numerical data consisted in the calculation of pair correlation coefficients as well as multiple correlation and regression analyzes.

3. Results of the investigation and their discussion

Epidemiological particularities of AS, including age and gender ones, are the subject of many studies [10, 11, 16]. So, Moore L.J. *et al*. collected in their meta-analysis the data which numbered 363 897 121 clinic patients [16]. It was found that the majority of septic patients were persons whose age was 60 years or more. The obtained data obtained confirm the significantly higher incidence of AS in elderly and senile patients - 31% compared with patients without sepsis - 20.4% ($p < 0.05$). Sex distribution, on the other hand, did not differ in the two groups.
Postoperative complications developed significantly more often in the group I patients (8.6%) rather than in the group II patients (2.8%) ($p<0.05$). Bleeding from the wound or in the abdomen, bile outflow, internal abscesses and acute adhesive intestinal obstruction were successfully eliminated. Mortality in the AS group significantly exceeded that in the group II, respectively, 10% versus 1.6% ($p < 0.05$).
The study revealed a statistically significant difference in LII and the absolute number of lymphocytes between the group I and group II patients (Table 1). The number of leukocytes in peripheral blood and erythrocyte sedimentation rate in groups of patients were not significantly different.

Table 1: Leukocyte profile and erythrocyte sedimentation rate in patients with abdominal sepsis and without

Group of Patients / Indices	group I n=100	group II n=184
Leukocytes, g/l	11,5	8,4
LII	5,0	3,4 *
Lymphocyte, g/l	0,5	1,4*
Erythrocyte sedimentation rate, mm/h	40,0	38,0

Note: available significant ($p < 0.05$) difference compared with the group "w ithout sepsis"

Further statistical analysis showed correlation between the LII connections and the number of SIRS criteria ($r = +0,34$; $p < 0.05$) which indicates a deepening of destructive processes in damaged organs and growth of multiple organ failure syndrome. An inverse relationship between the LII indicator and the absolute number blood lymphocytes of patients with AS ($r = -0,44$; $p < 0.05$) was also found which may be a result of the immunodeficiency deepening .
Only 54% of patients had hyperthermia syndrome manifestations, which partly differs from reports in the literature [18]. A significant percentage of patients without hyperthermia on the background septic condition can be a sign of immunoregulation exhaustion and rapid formation of immunosuppression in patients analyzed. Similar results were obtained by Bosmann and M. Ward P. [13], who studied the clinical and laboratory features of the immune system in septic patients.
The obtained in the study frequency of AS 77% and 23% - severe AS in patients with acute surgical diseases of the abdominal cavity is similar to the data obtained by Anantha RV *et al*. [15].
The state of the immune system in the patients with sepsis has a vital significance [9, 13, 15]. The study found that the complications of septic inflammation in patients is accompanied by a decrease in the absolute number of lymphocytes, which is likely to result from amplification of apoptosis in the background of endogenous and exogenous endotoxemia, which is characterized by an increase of LII [9, 12]. It is known that proapoptotic stimuli of lymphocytes lead to the development of immunosuppressive phase of sepsis [14]. Increase of LII [5, 7, 8] together with lymphopenia and a high ESR is a complex manifestation of immunodeficiency disorders with an immunoinflammatory and autoimmune

component that creates sepsis progression and induces risks of severe sepsis and septic shock, causing high mortality. The research of 335 patients with AS carried out by Drewry A. *et al*. confirms the patterns of lymphopenia and those of high mortality, which was 22.7% [9]. In our opinion, the changes of laboratory parameters are the result of deep cell-level immunopathological processes and metabolic disorders, which is confirmed by the modern theories of the AS. In clinical practice, reduced absolute number of lymphocytes in patients with AS should encourage doctors to review their approaches to the treatment of septic patients and evaluate them for the presence of new sources and types of infection. An important way to optimize the treatment of patients with abdominal sepsis is the search for early and highly informative markers of immunosuppression and its adequate correction.

4. Conclusions

1. Abdominal sepsis complicates acute surgical diseases of the abdominal cavity in 35.2% of cases.
2. Abdominal sepsis is significantly more frequent in elderly and senile patients ($p < 0.05$).
3. Postoperative complications (8.6% vs 2.8%) and mortality (10% vs. 1.6%) are significantly more likely to occur in patients with AS ($p < 0.05$).
4. Development of the AS is characterized by high level of LII and reduction of the absolute number of lymphocytes which is objective evidence of potentiated intoxication and immunosuppression.

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