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## Early diagnostics and treatment with acute burn sepsis

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### ABSTRACT

**Objective:** To determine the value of the procalcitonin test used for early diagnosis of sepsis and to study the course and treatment of burn sepsis in patients with severe burns.

**Methods:** Eighty patients in the Burn Department of Republican Scientific Centre of Emergency Medical Care, aged 17–75 years with burn injuries covering 30%–85% of the body surface, were enrolled in the study. Procalcitonin is marker of sepsis, procalcitonin > 2 ng/mL, sensitivity –89%, specific feature –94%.

**Results:** The result showed that among septic patients with severe burns, rational use of intensive therapy for burn sepsis and septic shock in combination with parenteral ozonotherapy resulted in decreases of syndrome of poly organ insufficiency and lethal outcomes from 70% accordingly. The result allows the conclusion that the treatment examined leads to a significant increase in survival coefficient.

**Conclusions:** This in turn confirms the efficacy of early necrectomy and auto dermo-plasty of deep burn wounds in victims with sepsis.

## 1. Introduction

Burn trauma remains one of the real problems of modern medicine, because of its heavy clinical course, the difficulties of treating the victims, the high mortality rate, and sometimes unacceptable results of treatment. However, according to the World Health Organization data, more than 95% of fatal fire-related burns in 2002, for example, occurred in low- and middle-income countries [1].

In spite of great success achieved in burn treatment, a lethal outcome among severely burnt patients remains high even in specialized hospitals. Lethality is particularly high in critical (40%–50% of body surface) and extra critical (over 50%) deep burns [2,3].

Burn sepsis is a systemic response to infection, characterized by inflammatory reaction symptoms on the background of a marked inflammatory process [4–6]. The data on contemporary statistics, devoted to patients with generalized inflammatory complications show their significant number and also identify the tendency for constant growth to 78%–80% [7–9].

In burn sepsis pathogenesis, an important role is played by anti-inflammatory cytokines: interleukine-1, tumor factor,

interleukine-6, interleukine-8 and others, which form specific body responses to so-called cytokine storms. Damage to different organs and tissues as a result of interleukine effects results in marked inflammatory disturbances, accompanied by development of interstitial edema (shock lung, shock kidney, etc.) formation of great number of circulating immune complexes, and others [10].

Severe burn trauma causes the systematic inflammatory response syndrome, which leads to damage from possible sepsis and severe sepsis development [11].

In light of the severity of these issues, the study aimed to determine the value of the procalcitonin test used for early diagnosis of sepsis and to study the course and treatment of burn sepsis in patients with severe burns.

## 2. Materials and methods

Over a period of 2010–2012, 80 patients with sepsis were treated at Burns Department of the Republican Scientific Centre of Emergency Medical Care, Samarkand, Uzbekistan. Generalization of purulent infection is most frequently marked in deep burns of more than 40% of the body surface [(45.1% ± 1.5%) on average]. The patients underwent procalcitonin test for early diagnosis.

Eighty patients aged 17–75 years with burn injuries covering 30%–85% of the body surface were enrolled in the study. All patients were admitted to the hospital during the first 12 h after

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the burn trauma. There were no thermoinhalation injuries or accompanying chronic diseases in all examined patients. For the purposes of the investigation, patients with sepsis were subdivided into 2 groups.

In addition to standard clinical laboratory test, the following were carried out: measurement of body temperature and heart rate, clinical and biochemical analyses of blood and urine, and microbiological analysis of discharge from burn wounds with determination of flora sensitivity to antibiotics according to the procalcitonin (PCT)-Q (BRAHMS, Germany) method of measuring PCT level in blood serum on 2, 3, 5, 7, and 10 days after the burn trauma.

PCT-Q is an immunochromatographic test for half-amount determination of PCT level, used for diagnosis and control of therapy for acute bacterial infections and sepsis. PCT-Q requires only a 30 min incubation period and not need calibration and additional apparatus. The advantages of this method include: simplicity of usage; absence of complex equipment; and short time for receiving results. To obtain PCT sensitivity findings, specific features, positive prognostic significance (PPS), and negative prognostic significance (NPS) were determined.

On the background of sepsis PCT concentration was ( $4.8 \pm 1.1$ ) ng/mL in the 50 patients in Group 1, sensitivity 67%, specific features 92%, PPS 85%, NPS 81%. For the 30 patients in Group 2, with severe course of sepsis, PCT level was ( $15.6 \pm 2.2$ ) ng/mL, sensitivity 3.3%, specific features 98%, PPS 83%, NPS 81%.

Analysis of microflora and its sensitivity to antibacterial preparations was carried out for 45 patients, aged 16–75 years, of whom 29 were males and 16 females, with deep burns covering 25%–65% of the body surface [(39.5%  $\pm$  5.0%) on the average].

Examination was carried out on admission, then on 4–5 and 10–15 day of treatment. For sterility, blood was taken from central vein. Cultivation of microorganisms was carried out according to standard methods of microbiological blood study on a double medium.

The result was estimated according to the presence of colonies of microorganisms. In addition, analysis of sowings from the wounds to microflora was carried out. Sensitivity to 15–20 antibiotics produced in foreign countries was determined in isolated pathogenetic and conventionally pathogenetic microorganisms.

### 3. Results

Group 1 consisted of 50 patients with Index Frank > 70 units, in the acute period of burn trauma (3–6 days); significant bacterial contamination (> 10.5 KOE/g) was revealed, PCT level was < 2 ng/mL and scale assessment was SOFA 11–12.

Group 2 consisted of 30 patients with severe burns with Index Frank > 100 units, PCT level of more than 2 ng/mL in all cases correlated with development of a burn sepsis clinical picture. In 5 patients with PCT levels of more than 10 ng/mL, specific features were 95%, and NPS 70%; diagnosis of burn sepsis was confirmed morphologically as well. Reliable effect on patients death was presented by PCT index > 2 ng/mL and scale assessment SOFA 18–20.

Thus, PCT test is prospective in diagnosis of burn sepsis. PCT levels in blood of more than 2 ng/mL in patients with burn trauma with Index Frank > 70 units in the acute period of burn injury is evidence for the expediency of performing a deescalation regimen of antibacterial chemotherapy.

In 50 (62.5%) patients with burns (Group 1) with signs of burn sepsis, standard intensive therapy with intravenous infusion of 200 mL ozonized physiological solution was performed during the term of ( $11.54 \pm 2.11$ ) days after receiving burns, with ozone concentration of 4 mg/L the fluid, once every 24 h for 10 days at the stage of burn shock and acute burn toxemia.

The 30 patients with burns in Group 2 showed Frank Index of  $105.75 \pm 3.54$  conventional units and signs of burn sepsis. Complex intensive therapy was carried out during 10–11 days after receiving burn trauma (at stage of burn shock and acute burn toxemia).

In blood sowings with positive results, 13 cases (37.2%) showed resistance to *Staphylococcus aureus* (*S. aureus*), 10 cases (28.6%) to *Enterococcus*, 5 cases (14.3%) to *Pseudomonas aeruginosa* (*P. aeruginosa*), with these 74.3% were polyresistant strains (Table 1).

Of the studied samples, 42 cases showed positive results to *S. aureus* (37.8%), 30 cases to bacteria of intestinal bacilli (27.1%), 20 cases to *P. aeruginosa* (18.0%). Polyresistance of microorganisms from wounds to antibacterial preparations was noted in 63.1% in purulent strains of burn wound (Table 2).

The most frequent strains of sepsis are *S. aureus* and *P. aeruginosa*, which are discharged from burn wounds and, according to our findings, predominate at 65%–85% in septic patients. Correlation of sowing of *S. aureus* and *P. aeruginosa* strains in patient blood with burn sepsis is 2:1. Less often, the agents of sepsis are *Escherichia coli*, *Acinetobacter* spp., *Enterobacter* spp., B-hemolytic streptococcus, and non-sporogenetic anaerobic bacteria. The most severe septic course is noted in discharge of three or more microorganisms in hemoculture.

Taking into account clinic laboratory findings (Hb, A/G coefficient, lymphocytes, leucocytes, body temperature higher than 38 °C) and 3 times Regis rated bacterimia, we diagnosed sepsis in 80 patients with burns, which accounts for 4.1% of the total number of victims and 38% among patients with severe burns.

In septic patients with rate of heart beats more than 90 b/m, respiratory rate more than 20 per minute, average Hb level 72 g/L, lymph of 11%, A/G coefficient of 0.97, there was marked leucocytosis of more than  $12 \times 10^6$ /mL or leukopenia of less than  $4 \times 10^6$ /mL or the immature form of more than 10% and body temperature higher than 38 °C or lower than 35 °C.

In patient with critical burns, the risk of developing generalized infections complications increases. When such patients have deep burns covering more than 20% of the body surface, they undergo complex therapy consisting of antibacterial preventive therapy and then treatment of complications

**Table 1**

Type of strains isolated from the blood of patients with burns.

Type of strains	Number of samples		Including resistant	
	<i>n</i>	%	<i>n</i>	%
<i>S. aureus</i>	13	37.2	11	31.4
<i>Enterococcus</i> spp.	10	28.6	10	28.7
<i>P. aeruginosa</i>	5	14.3	2	5.8
<i>Staphylococcus epidermidis</i>	3	8.6	1	2.8
<i>Candida</i> spp.	2	5.7	0	0.0
<i>E. coli</i>	1	2.8	1	2.8
<i>Acinetobacter</i> spp.	1	2.8	1	2.8
Total	35	100.0	26	74.3

*E. coli*: *Escherichia coli*.

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