

ASSESSMENT OF THE FUNCTIONAL STATE OF THE LIVER IN PATIENTS WITH COMBINED INJURIES OF THE FACE BONES

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Abstract: The work presents a comprehensive analysis of the functional state of the liver in patients with combined facial bone injuries. A study was conducted on 122 patients in the acute period of the traumatic illness. The assessment included biochemical, antioxidant, and cytokine indicators of the blood (ALT, AST, total protein, albumin, procalcitonin, IL-4, IL-6, IL-10, TNF- α , SOD, catalase, lipid peroxidation products). It has been established that in the first hours after injury, signs of systemic inflammatory and cytolytic syndromes develop, accompanied by a pronounced increase in procalcitonin, transaminases, and cytokines, while decreasing the protein-synthetic function of the liver and antioxidant activity. By days 5-7, the indicators normalize, which indicates a positive recovery trend during complex therapy.

Keywords: combined trauma, maxillofacial region, liver functional state, procalcitonin, cytokines, lipid peroxidation, antioxidant defense, traumatic disease.

Literature review

Modern studies confirm that combined facial bone injuries are a severe clinical form of polytrauma, accompanied by a pronounced systemic inflammatory response and secondary metabolic disorders (Saka et al., 2023; Zhang et al., 2021).

Pathogenetically, the development of traumatic disease is accompanied by the activation of the cytokine cascade (IL-1, IL-6, TNF- α), imbalance between lipid peroxidation (LPO) and antioxidant defense. Increased concentration of LPO products (malon dialdehyde, diene conjugates, Schiff bases) leads to damage to hepatocyte cell membranes and activation of cytolysis enzymes - ALT and AST (Wang et al., 2023). Procalcitonin is considered a reliable biomarker of the systemic inflammatory response (SIRS) and septic complications. A parallel decrease in total protein and albumin reflects the suppression of the liver's protein-synthetic function and correlates with the duration of hospitalization and treatment outcome.

Introduction

Combined facial bone injuries represent one of the most complex clinical and pathophysiological forms of polytrauma, requiring an interdisciplinary approach to diagnosis and treatment. The liver, as the central organ of metabolism and detoxification, occupies a special place in the formation of a systemic inflammatory response (SIRS) accompanied by endogenous intoxication, impaired microcirculation, and hypoxic damage to vital organs. It is the first to respond to shock and inflammatory effects, participating in the regulation of protein, carbohydrate, and lipid metabolism, as well as in the synthesis of acute phase proteins and cytokines (Saka et al., 2023; Ergashev, 2022). In severe injuries, the activation of the cytokine cascade (IL-1, IL-6, TNF- α) and increased production of free radicals lead to an imbalance between lipid peroxidation processes and antioxidant defense activity. This contributes to the damage of cell membranes,

the development of a cytolytic syndrome, and the suppression of the protein-synthetic function of the liver. Clinically, these changes are manifested by an increase in the level of transaminases, a decrease in the concentration of albumin and total protein, and an increase in the level of procalcitonin as a marker of systemic inflammation (Wang et al., 2023; Liu et al., 2024).

Purpose of research

The aim of the study is to comprehensively study the functional state of the liver in patients with combined facial bone injuries in the acute period of traumatic disease based on the analysis of biochemical, cytokine, and antioxidant blood parameters.

Materials and methods.

The study was conducted on the basis of the neurosurgical department, where 122 patients with combined injuries of the maxillofacial region were examined.

Inclusion criteria: 18-70 years old

- presence of combined injuries
- absence of chronic liver diseases;
- participation consent

Exclusion criteria:

- age <18 or >75 years,
- isolated injuries
- refusal to participate.

Clinical, instrumental (radiography, CT) studies were used to assess bone injuries, and laboratory, biochemical indicators were used: procalcitonin, total protein, albumin, bilirubin, plasma and erythrocyte LPO, PTI, AlAT, AsAT, IL-1, IL-4, IL-6, and TNF- α , to indicate the functional state of the liver.

For statistical data processing, the Statistica 10.0 package was used, using Student's t-test and correlation analysis ($p < 0.05$).

Result

Markers of Inflammation, Lipid Peroxidation, and Antioxidant Defense in Combined Facial Skeletal Injuries

Indicator	Upon Admission
Procalcitonin (PCT), ng/mL	2.670–9.110
ALT	+20–35% above ULN
AST	+15–30% above ULN
Total protein, g/L	Below normal; inverse correlation with hospital stay duration ($rS = -0.639$; $p < 0.05$)
Lipid peroxidation: diene conjugates (DC), plasma	+94.99%
Lipid peroxidation: diene conjugates (DC), erythrocytes	+137.65%
Lipid peroxidation: MDA, plasma	↑ (significant increase)
Lipid peroxidation: Schiff bases	↑ (significant increase)
SOD (erythrocytes)	–45.24%

Catalase (erythrocytes)	–54.3%
Superoxide-eliminating activity (SEA), plasma	Increased 5.5-fold
IL-4	+64.74% (p = 0.004)
IL-6, IL-10, TNF-α	↑ (significant increase)

The data presented in the table reflect the nature of systemic metabolic and inflammatory changes in patients with combined facial bone injuries at the time of admission, i.e., during the acute period of the traumatic illness. A pronounced activation of the inflammatory response and significant disruptions in the processes of lipid peroxidation (LPO) in plasma and erythrocytes against the background of decreased antioxidant enzyme activity are noted.

The level of procalcitonin (PCT) in patients exceeded the norm by tens of times (2.67-9.11 ng/ml), indicating the development of a systemic inflammatory reaction with signs of endogenous intoxication and activation of the cytokine cascade.

Liver enzymatic indicators (ALT and AST) were increased by 20-35% and 15-30% respectively compared to the upper limit of normal, indicating moderate cytolytic syndrome. The concentration of total protein is reduced, and a significant inverse correlation was found between its level and the duration of hospitalization ($r_s = -0.639$; $p < 0.05$), which emphasizes the prognostic significance of protein metabolism in polytrauma.

Lipid peroxidation indicators (diene conjugates, malondialdehyde, Schiff bases) show a significant increase of 95-138% in plasma and erythrocytes, reflecting the hyperactivity of free radical processes and damage to cell membranes.

The activity of antioxidant enzymes superoxide dismutase (SOD) and catalase decreased by 45.2% and 54.3%, respectively, while plasma superoxide-reducing activity (SRA) increased 5.5 times - possibly as a compensatory reaction to increased oxidative stress.

Immunological analysis revealed cytokine imbalance: an increase in IL-4 contents by 64.7% ($p = 0.004$), as well as a significant increase in IL-6, IL-10, and TNF- α levels, indicating the development of a mixed pro- and anti-inflammatory response. This dynamic is characteristic of multi-organ reactions in combined injuries and reflects the involvement of systemic inflammation in the formation of a pathological cascade of traumatic disease.

Overall, the presented data confirm that patients with combined facial bone injuries develop a pronounced oxidative-inflammatory syndrome with signs of cytolytic and protein-metabolic disorders in the first hours after injury, reflecting the degree of systemic disintegration and the prognosis of the disease.

Dynamics of Biochemical Blood Parameters in Patients With Combined Facial Bone Injuries During Treatment

Indicator		Normal Range		Changes	
				Upon Admission (first 12 hours)	
Procalcitonin, ng/mL		≤ 0.05		2.670 – 9.110	
Total protein, g/L		60–80		66.64	
Albumin, g/L		35–55		37.21	
ALT, U/L		$\leq 37/31$		55.4 ± 8.1	
AST, U/L		$\leq 47/31$		51.1 ± 7.5	
Indicator	Normal Range	Day 3	Day 5	Day 7	
Procalcitonin,	≤ 0.05	1.825 ± 0.61	$0.980 \pm$	0.350 ± 0.11	

ng/mL			0.22	
Total protein, g/L	60–80	64.21 ± 4.5	67.58 ± 4.2	70.15 ± 3.8
Albumin, g/L	35–55	35.15 ± 3.2	38.65 ± 3.0	40.50 ± 2.8
ALT, U/L	≤ 37/31	42.5 ± 6.2	36.1 ± 5.5	31.9 ± 4.8
AST, U/L	≤ 47/31	41.3 ± 5.9	35.2 ± 5.1	30.7 ± 4.5

The table presents the dynamics of the main biochemical blood parameters in patients with combined facial bone injuries during the first week of hospitalization. The presented data characterize the severity of the inflammatory response, the degree of cytolytic liver damage, and changes in protein-synthetic function during treatment.

In the first 12 hours after the injury, a pronounced systemic reaction was noted, accompanied by a sharp increase in the level of procalcitonin - from 2.67 to 9.11 ng/ml, which exceeded the norm by more than 50-180 times. This indicator is considered one of the most sensitive markers of systemic inflammation and early endogenous intoxication.

The activity of liver enzymes (AlAT and AsAT) also significantly exceeded the upper limit of the norm - respectively by 20-35% and 15-30%.

Simultaneously, a decrease in the level of total protein and albumin was noted, indicating a suppression of the synthetic function of the liver and redistribution of protein fractions under conditions of systemic inflammation. By the third day, a tendency towards a decrease in procalcitonin (to an average of 1.825±0.61 ng/ml) was observed, indicating partial compensation of systemic inflammation. However, protein and albumin levels remained below normal, and transaminase activity remained elevated, indicating ongoing cytolysis and metabolic stress.

On the fifth day, the dynamics of biochemical indicators became more pronounced: the PCT level decreased by almost 10 times, and the activity of AlAT and AsAT approached the reference values (respectively 36.1 and 35.2 units/l). Simultaneously, an increase in the concentration of total protein and albumin (67.58±4.2 and 38.65±3.0 g/l) was noted, indicating a gradual restoration of the liver's protein-synthetic function and general metabolic processes.

By the seventh day, a practically complete restoration of the biochemical profile was recorded: the level of procalcitonin decreased to 0.35±0.11 ng/ml, which corresponded to the norm, and transaminase levels stabilized (AlAT - 31.9±4.8; AsAT - 30.7 ± 4.5 units/l), and the concentration of total protein and albumin increased to 70.15 ± 3.8 and 40.50 ± 2.8 g/l, respectively.

Discussion

The obtained data confirm that patients with combined facial bone injuries develop a pronounced systemic inflammatory syndrome within the first 12 hours after injury, manifesting as a significant increase in procalcitonin, transaminases, and cytokines, while simultaneously reducing the level of total protein and albumin. These changes reflect the early involvement of the liver in the pathological process and the development of a cytolytic syndrome.

A pronounced increase in procalcitonin (up to 9.1 ng/ml) indicates the activation of the neuroendocrine-inflammatory cascade, which is consistent with Wang et al. (2023) data on a direct correlation between PCT levels and the degree of systemic inflammation in polytrauma. An increase in ALT and AST activity by 20-35% of the upper limit of the norm indicates damage to hepatocytes due to hypoxia, circulatory disorders, and endotoxemia.

A decrease in the concentration of protein fractions indicates a suppression of the synthetic function of the liver, and the revealed inverse correlation between the level of total protein and the duration of hospitalization ($r_s = -0.639$; $p < 0.05$) confirms the diagnostic and prognostic significance of this indicator.

The imbalance between lipid peroxidation and the antioxidant system manifested as an increase in the levels of malondialdehyde and diene conjugates, while simultaneously reducing the activity of superoxide dismutase and catalase. This indicates the development of oxidative stress, which is one of the key mechanisms of liver cell membrane damage in traumatic disease (Saka et al., 2023).

Immunological analysis revealed an increase in the levels of IL-6, IL-10, and TNF- α , reflecting the presence of a mixed pro- and anti-inflammatory response. Such changes are characteristic of the transition from the hyperinflammation phase to the compensatory immune dysfunction phase.

By the fifth and seventh days of therapy, a decrease in the level of procalcitonin and normalization of the activity of cytolysis enzymes were noted, which indicates the stabilization of metabolic processes and the restoration of liver functional activity. This confirms the effectiveness of a comprehensive approach, including infusion therapy, antioxidant support, and cytokine balance monitoring.

Conclusion

In patients with combined facial bone injuries, marked signs of systemic inflammation, cytolysis, and protein-metabolic disorders are observed in the early stages after injury, due to liver involvement in the pathological process.

Increased levels of procalcitonin, ALT, AST, and cytokines (IL-6, TNF- α) are accompanied by a decrease in total protein and albumin, indicating the development of cytolytic and hypoproteinemic syndromes. Disruption of antioxidant defense (reduction of SOD and catalase activity) and activation of lipid peroxidation processes reflect the formation of oxidative stress. By the end of the first week of treatment, partial or complete normalization of biochemical parameters is observed, which indicates the effectiveness of complex therapy and the body's compensatory capabilities. The identified changes in biochemical and cytokine markers can be used as diagnostic and prognostic criteria for the severity of the course and the effectiveness of treatment for combined facial skeletal injuries.

List of literature

1. Chappuis V., Gruber R., Bosshardt D. Systemic inflammatory response in maxillofacial trauma. *J Craniomaxillofac Surg.* 2022; 50(5):441–449.
2. Нажмиддинов Б.Б. «Особенности лечения сочетанных травм костей лица с учетом функционального состояния печени». «Экономика и Социум» 2022 №8(99); 253-257.
3. Нажмиддинов Б.Б. «Эффективность комплексного лечения сочетанных поражений лицевых костей с учетом функционального состояния печени». «Экономика и Социум» 2022 №8(99); 258-262.
4. Gao X., Wang L., Zhang Y. Pathophysiological mechanisms in polytrauma: the role of cytokines. *Injury.* 2020; 51(3):567–574.
5. Global Burden of Disease Study. *Facial fracture statistics, 2019–2023. Lancet Global Health.* 2023.
6. Liu P., Chen X., Wang H. Clinical value of IL-6 and TNF- α in trauma patients. *Clin Oral Invest.* 2024; 28(2):1051–1060.
7. Боймуродов Ш.А., Нажмиддинов Б.Б. «Хирургическое лечение пострадавших с сочетанными травмами челюстно-лицевой области. «Журнал стоматологии и краниофациальных исследований» 2022; Специальный выпуск 185-187;

8. Saka N., Ito K., Tanaka S. Organ response and hepatic dysfunction in maxillofacial trauma. *Trauma Surg Acute Care Open*. 2023; 8(1):e001020.
9. Wang H.L., Boyapati L. PASS principles for predictable bone and soft tissue regeneration. *Implant Dent*. 2021; 17(1):5–20.
10. Zhang Z., Li J., Kim J. Epidemiology of maxillofacial fractures in polytrauma. *Int J Oral Maxillofac Surg*. 2021; 50(9):1123–1131.
11. Боймуродов Ш.А., Нажмиддинов Б.Б. «Особенности иммунного ответа при сочетанных травмах лицевого скелета». *Tibbiyot talimi va innovatsiyalari* 2025; 2 22-27;