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COMPARATIVE ANALYSIS OF REGENERATIVE POTENTIAL INDICATORS IN PATIENTS WITH GUNSHOT AND NON-GUNSHOT MAXILLOFACIAL INJURIES

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ПОРІВНЯЛЬНИЙ АНАЛІЗ ПОКАЗНИКІВ РЕГЕНЕРАЦІЙНОГО ПОТЕНЦІАЛУ ОРГАНІЗМУ У ПОСТРАЖДАЛИХ З ВОГНЕПАЛЬНИМИ ТА НЕВОГНЕПАЛЬНИМИ УРАЖЕННЯМИ ЩЕЛЕПНО-ЛИЦЕВОЇ ДІЛЯНКИ

INFORMATION

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ABSTRACT

Aim of the study. The aim of the study was to comparatively investigate changes in the main components of peripheral blood that directly affect the regeneration of damaged tissues in patients with gunshot and non-gunshot injuries of the maxillofacial tissues.

Materials and methods. The study included 27 patients aged 30–35 years with traumatic open fractures of the mandible of gunshot and non-gunshot origin, accompanied by soft tissue injuries. Among them, 14 patients had gunshot injuries, and 13 patients had fractures resulting from road traffic accidents (RTA).

Patients with gunshot injuries were admitted to the Department of Surgical Dentistry and Maxillofacial Surgery for further treatment on the 7th–10th day after osteosynthesis with titanium mini-plates using the intraoral method in hospitals of the Armed Forces of Ukraine. The fractures were localized in the body and angle of the mandible. Patients who sustained injuries in RTAs underwent similar surgical interventions. Healing of soft tissue wounds in both groups of patients was uncomplicated.

Peripheral blood parameters were analyzed once, in an automated mode, on the 7th–10th day after injury at the laboratory of the Ternopil Regional Clinical Hospital. The following parameters were assessed: platelet count, total protein level, neutrophil and lymphocyte counts, and the neutrophil-to-lymphocyte ratio (NLR).

Results and discussion. The study revealed that the platelet count in patients with gunshot injuries was significantly higher compared to patients who sustained soft tissue injuries of the maxillofacial area in road traffic accidents (RTA). However, the total protein level in the blood of patients with gunshot injuries was significantly lower. A difference was also observed in the neutrophil-to-lymphocyte ratio, which was lower in patients with gunshot wounds. The number of neutrophils did not differ significantly between the compared groups.

Conclusions. The comparison of regenerative capacity indicators in patients with gunshot and non-gunshot injuries shows that gunshot injuries have a more pronounced effect on structural and functional disturbances in remote areas of the body due to their higher kinetic energy. Among the studied indicators of regenerative capacity, the following were identified: a significant increase in platelet count, a decrease in total protein levels in the blood, and a lower neutrophil-to-lymphocyte ratio in patients with gunshot wounds.

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Ключові слова: вогнепальні та невогнепальні ураження тканин ЩЛД, регенераційна здатність організму, периферична кров.

АНОТАЦІЯ

Патогенез вогнепальних ран, на відміну від інших травматичних ушкоджень, має низку особливостей, пов'язаних із високою кінетичною енергією раневого агента, що зумовлює розвиток системних функціональних порушень в організмі [10, 13, 14]. Однією з перших ланок, яка зазнає впливу, є система периферичної крові, тому зміни кількості формених елементів крові, які безпосередньо беруть участь у загоєнні ран, можна трактувати як один із показників регенераційної здатності організму [12, 15].

Мета дослідження. У порівняльному аспекті дослідити зміни основних компонентів периферичної крові, які безпосередньо впливають на регенерацію пошкоджених тканин, у постраждалих з вогнепальними і невогнепальними ураженнями тканин ЩЛД.

Матеріали і методи. Для дослідження відібрано 27 постраждалих віком від 30 до 35 років із травматичними відкритими переломами нижньої щелепи вогнепального і невогнепального характеру, які супроводжувались травмою м'яких тканин. Серед них вогнепальні ураження були у 14 постраждалих, у 13 постраждалих – переломи, отримані у дорожньо-транспортних пригодах (ДТП). Постраждалі з вогнепальними ураженнями поступали відділення хірургічної стоматології та щелепно-лицевої хірургії для подальшого лікування після проведення остеосинтезу у шпиталях Збройних Сил України на 7–10 день після проведення остеосинтезу титановими мініпластинами внутрішньоротовим методом. Переломи локалізувались в межах тіла і кута нижньої щелепи. Постраждалим, які отримали травми в ДТП проводились аналогічні оперативні втручання. Загоєння ран м'яких тканин у постраждалих обох груп протікало без ускладнень.

Дослідження показників периферичної крові проводилось в автоматизованому режимі одноразово на 7–10 день після травми в лабораторному відділення Тернопільської обласної клінічної лікарні. Визначали наступні показники: кількість тромбоцитів, рівень загального білка, кількість нейтрофільних лейкоцитів, лімфоцитів і вираховували нейтрофільно-лімфоцитарне співвідношення (НЛС).

Результати та їх обговорення. В результаті досліджень встановлено, що кількість тромбоцитів у постраждалих, які отримали вогнепальні ураження була достовірно вищою у порівнянні з постраждалими, які отримали травми м'яких тканин ЩЛД у ДТП. Однак рівень загального білка в крові у при вогнепальному ураженні був достовірно нижчим. Також виявлено різницю у нейтрофільно-лімфоцитарному співвідношенні – воно було меншим у постраждалих з вогнепальними пораненнями. Кількість нейтрофільних лейкоцитів у порівнюваних групах суттєво не відрізнялась.

Висновки. Отримані результати порівняння показників регенераційної здатності організму у постраждалих з вогнепальними і невогнепальними травмами свідчать про особливості реакції організму на різний вид травми. Вогнепальні ураження чинять більш виражений вплив на структурно-функціональні порушення у віддалених ділянках організму за рахунок їх більшої кінетичної енергії. Серед досліджених показників регенераційної здатності організму встановлено наступне: достовірне збільшення кількості тромбоцитів, зниження кількості загального білка в крові у осіб з вогнепальними пораненнями, а також нижчий коефіцієнт нейтрофільно-лімфоцитарного співвідношення.

Introduction. Treatment of wounds resulting from the use of military weapons has become extremely relevant in Ukraine today [1, 6, 13, 18]. Gunshot wounds of the maxillofacial area, unlike injuries of domestic origin and injuries resulting from road accidents, constitute a special type of injury, since the conditions of their occurrence and the specifics of the damaging factor significantly affect the course of treatment and further rehabilitation of victims [2, 5, 7, 10, 14].

Own clinical observations, as well as literature data [1, 2, 6, 7, 10, 13, 18] indicate that gunshot wounds are characterized by a more severe course and require a longer rehabilitation period. It is known that the restoration of damaged tissues occurs with the participation of the immune, endocrine and nervous systems, provided that there is sufficient provision of plastic material [15, 16]. Immunocompetent cells play a significant role in the wound healing process, and changes in their quantitative composition significantly affect the intensity and speed of regenerative processes [12, 15].

Analysis of the available literature showed the presence of studies describing the course of gunshot wounds of the maxillofacial region [1, 2, 6, 7, 13, 18, 19]. At the same time, we were unable to find works devoted to the study of the regenerative potential of the organism in such cases, which determined the main goal of our study [15, 16].

Purpose of the work. In a comparative aspect, to evaluate changes in key peripheral blood components that directly affect the process of regeneration of damaged tissues in patients with gunshot and non-gunshot injuries of the maxillofacial region, in order to determine the features of recovery mechanisms and prospects for optimizing treatment and rehabilitation measures.

Material and methods. The study selected 27 victims aged 30 to 35 years with traumatic open unilateral fractures of the lower jaw of a gunshot and non-gunshot nature, accompanied by soft tissue trauma. Among them, 14 victims had gunshot wounds, 13 had fractures received in a road accident. Victims with gunshot wounds were admitted to the department of surgical dentistry and maxillofacial surgery for further treatment after osteosynthesis in hospitals of the Armed Forces of Ukraine on the 7th–10th day after osteosynthesis with titanium miniplates by the intraoral method. The fractures were localized within the body and angle of the lower jaw. Victims who received injuries from road accidents underwent similar surgical interventions. Healing of soft tissue wounds in victims of both groups proceeded without complications.

The study of regeneration indicators was conducted in an automated mode once on the 7th–10th day after the injury in the laboratory department of the Ternopil Regional Clinical Hospital. The following indicators were determined: the number of platelets, the level of total protein, the number of neutrophil leukocytes, lymphocytes, and the neutrophil-lymphocyte ratio (NLR) was also calculated. According to the literature [12, 15, 16, 1, 18], these cell populations were selected because they are important for the formation of the body's reactivity and are directly involved in the course of wound healing and the processes of regeneration of damaged tissues.

Statistical processing of the obtained results was carried out using the Microsoft Excel program. The results are displayed as mean values and standard error (M ± m). The assessment of the reliability of the values by the Student's t-test was carried out using the STATISTICA 6.1 program. The obtained values of $p \leq 0.05$ were considered statistically significant.

Statistical analysis of the obtained results of the study of blood parameters, which are presented in Table 1, indicates a significant difference in their quantitative changes. According to the results of the study, the number of platelets in victims with gunshot wounds significantly exceeded them in comparison with victims who were injured in a road accident. The explanation of this fact is as follows. According to modern ideas, a wound projectile (bullet, fragment) when in contact with tissues not only destroys them, but also transfers significant kinetic energy to them, which causes a complex of structural and functional disorders in remote areas, such as: microcirculation disorders in the form of ischemia, thrombosis, avascular necrosis, which is caused by damage to the intima of blood vessels, activation of proteolysis and the release of lysosomal enzymes that have a systemic effect.

Table 1

Research results and their discussion
Comparative analysis of the body's regenerative capacity in victims with gunshot and non-gunshot injuries to the maxillofacial region

Blood parameters	Average values of the indicators under study, M ± m		Reliability of the difference in results
	Gunshot injuries n = 14	Non-gunshot injuries n = 13	
PLT, 10*9/L	457,1 ± 61,50	222,5 ± 16,74	p ≤ 0,05
Total protein, q/L	69,0 ± 2,80	75,5 ± 1,43	p ≤ 0,05
Leukocytes, 10*9/L	7,4 ± 1,36	7,9 ± 1,23	p ≥ 0,05
Lymphocytes, abs.	33,3 ± 3,86	23,0 ± 2,70	p ≤ 0,05
Neutrophil-lymphocyte ratio (NLR)	3,18 ± 0.35	5,12 ± 0.81	p ≤ 0,05

The initiation of the tissue repair process is as follows: activated platelets release a significant amount of growth factors (PDGF, TGF-β, VEGF, EGF), in addition, these factors stimulate other cells that are directly involved in wound healing and the formation of new tissue: macrophages, which clean the wound in the early period after injury, fibroblasts for the synthesis of newly formed tissue in the area of injury, as well as endothelial cells for the formation of new blood vessels.

The data obtained on the amount of protein (Table 1) indicate a decrease in its content in victims with gunshot wounds. The explanation for this fact is as follows. Proteins in the body have various functions, the main of which is providing the necessary material for the construction of new cells. In addition, they participate in the synthesis of enzymes, the production of antibodies and hormones. The healing of gunshot wounds requires significant energy resources, which are formed during the breakdown and redistribution of protein molecules, therefore, the healing of gunshot wounds significantly depletes the protein reserve of the body.

When analyzing the number of neutrophils, no significant difference was found between the compared groups. In patients injured in road accidents, only a slight tendency to increase their number was observed.

Further studies have shown that in individuals who received gunshot wounds, the absolute number of lymphocytes was significantly higher (Table 1). However, the average values of the indicators reflect only general trends of changes and do not demonstrate a detailed picture of quantitative changes between individual pools of neutrophil leukocytes. In recent years, attention has been focused on the neutrophil-lymphocyte ratio (NLR) as an indicator that largely determines the prognosis of the course of the disease or injury [6, 7, 13]. NLR is easily measured and, according to researchers [12, 15, 16], reflects the level of the body's stress response or systemic inflammation. It has also been established that an increase in the number of neutrophils against a background of a decrease in the number of lymphocytes negatively affects the wound healing process [8, 10].

Our studies show that the number of neutrophil leukocytes in both compared groups was approximately equal, however, the absolute number of lymphocytes was significantly higher in individuals who received gunshot trauma, which is confirmed by a lower neutrophil-lymphocyte ratio (NLR) (Table 1).

Conclusions. The obtained results of comparing the indicators of the body's regenerative capacity in victims with gunshot and non-gunshot injuries indicate the peculiarities of the body's reaction to different types of trauma.

1. Gunshot injuries have a more pronounced effect on structural and functional disorders in remote areas of the body due to their greater kinetic energy.

2. Among the studied indicators of the body's regenerative capacity, the following were found: a significant increase in the number of platelets, a decrease in the amount of total protein in the blood in people with gunshot wounds.

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