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NO-DEPENDENT FACTOR IN REGULATION OF MICROCIRCULATION DURING EXPERIMENTAL THERMAL TRAUMA

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ABSTRACT — The aim of the study was to evaluate the microcirculatory response to experimental thermal trauma by using laser Doppler flowmetry. The conducted research allowed us to verify the non-linear nature of changes in the intensity of microcirculation in a burn wound, demonstrating both a stress and compensatory responses. It is revealed that NO-dependent mechanisms can play a key role in their provision.

KEYWORDS — burn, wound, microcirculation, nitric oxide, laser Doppler flowmetry.

INTRODUCTION

It is known that microcirculation disorders serve as an important link in the pathogenesis of thermal trauma, appearing both locally (in the tissues of the burn wound and the parawound zone) and systemically [1, 4]. At the same time, the mechanisms for forming such shifts differ significantly [1, 2, 4–6]. Thus, systemic dysfunction of the microcirculatory bed in severe burns is primarily due to the centralization of blood circulation and endotoxicosis. On the contrary, microcirculatory disorders in the burn wound area are mainly associated with direct tissue damage, blood stasis, and progressive DIC syndrome [1, 4]. On the other hand, regardless of the mechanism, the severity of these disorders needs to be assessed in a timely manner, since it affects the choice of treatment tactics (including drug therapy) [2, 6, 7]. Also, verification of the state of the microcirculation system serves as a tool for monitoring the effectiveness of local treatment [3, 6, 7]. In addition, understanding the nature and dynamics of the microcirculatory response to thermal trauma is important for the development of innovative methods of sanogenetic impact [2, 5]. At the same time, most of the existing methods for studying the state of microcirculation are either complex in execution and require the use of exclusive equipment [1, 2, 6], or do not have sufficient depth of penetration and, consequently, informativity [5, 7]. In this regard, the ***aim of the study*** was to evaluate the microcirculatory response to experimental thermal trauma by using laser Doppler flowmetry.

MATERIAL AND METHODS

The study was performed on 20 male Wistar rats divided into two equal groups. Only a single measurement of microcirculation parameters was performed in the first (control) group of animals. The rats of the second (main) group under combined anesthesia (zoletil + xylavet) sustained simulated thermal burn on the pre-epilated surface of the back (area — 20% of the body surface, depth — II degree) according to the previously developed and patented method (Peretyagin S.P. et al., 2009). Starting from the first day, all animals of the second group were treated locally (*levomekol* liniment).

The microcirculation parameters were registered for 3 minutes using laser Doppler flowmetry on the "LAKK-02" device (Moscow, Russia) [3]. The intensity of blood flow through microvessels was estimated by the microcirculation index (measured in perfusion units). The role of individual factors in ensuring microcirculation was also studied using amplitude-frequency analysis: intravascular (endothelial, neurogenic and myogenic) and external (cardiac and respiratory) components.

Statistical analysis of the results was performed using the program Stastica 6.1 for Windows.

RESULTS

It was found that after applying the burn, the main integrative parameter (the microcirculation index) demonstrates nonlinear dynamics (Fig. 1). In the immediate post-traumatic period (after 1 hour), a sharp decrease in the intensity of microcirculation was observed (by 2.99 times; $p<0.05$), followed by a compensatory increase almost to the physiological level by 24 hours. However, in the future, a progressive decrease in the indicator was registered.

Analysis of the regulatory components allowed us to establish that the maximum coincidence of the dynamics of the microcirculation index occurs for the endothelial component (Fig. 2), the level of which is

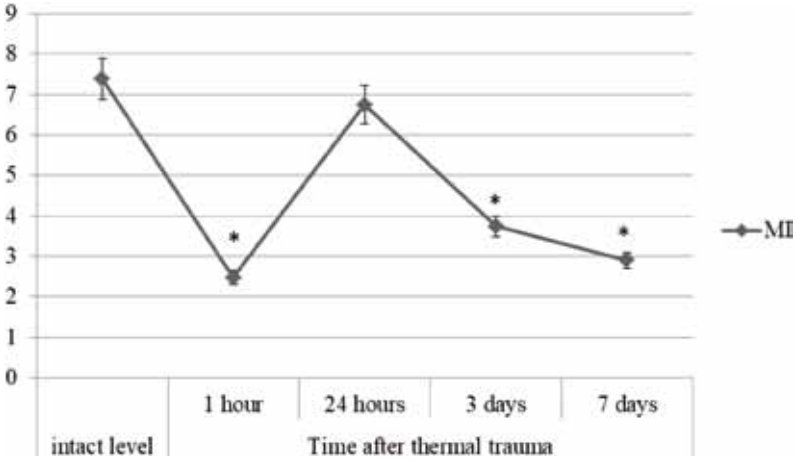

Fig. 1. Dynamics of the level of microcirculatory index (MI) during experimental burn (asterics indicates statistically valued differences, p<0,05)

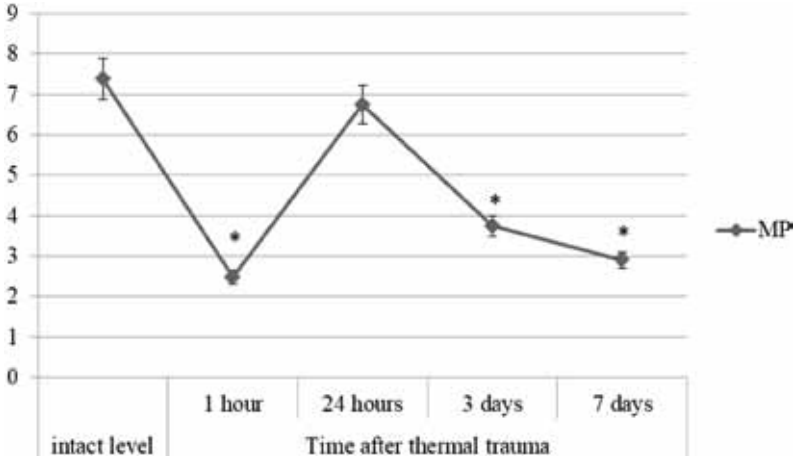

Fig. 2. Dynamics of the endothelial component of microcirculation regulation during experimental burn (asterics indicates statistically valued differences, p<0,05)

directly determined by the release of NO by endothelial cells. The correlation coefficient of these parameters was 0.96, which suggests a key role of this compound in regulating the intensity of blood flow through the microvessels of a burn wound in the dynamics of regenerative processes.

CONCLUSION

The conducted research allowed us to verify the non-linear nature of changes in the intensity of microcirculation in a burn wound, demonstrating both a stress response and compensatory responses. It is revealed that NO-dependent mechanisms can play a key role in their provision.

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