Katarzyna Gałecka

Physiological parameters of platelets in the process of animal hemodialysis and their changes induced by radiation in the near infrared range (NIR)

SUMMARY

One of the methods used to purify the blood of harmful metabolic products and toxins is hemodialysis. This technique uses extracorporeal circulation, which results in damage to the morphotic elements of the blood, disorders of the coagulation system, and leads to inflammation. The consequence of these disorders are complications requiring extended diagnostics and treatment reducing the effectiveness of the therapies used and the potential survival of patients.

This work was part of the WROVASC project, which was coordinated by the Regional Specialist Hospital in Wrocław. In this project, the subject of the research was the impact of extracorporeal circulation on blood morphotic elements and the potential benefits of using near infrared radiation (NIR) as a protective tool. My work focused on one of the elements, which are platelets. The scientific objective of my doctoral dissertation was to investigate the effect of near-infrared (NIR) radiation on platelets during extracorporeal circulation in hemodialysis. The implementation of this goal included the development and testing of a proprietary method for testing platelet activity based on the assessment of membrane fluidity using electron paramagnetic resonance (EPR) spectroscopy. I used this method in conjunction with the techniques for measuring platelet aggregate ability (impedance aggregometry) to assess the state of their activity in a series of hemodialysis procedures in animals undergoing bilateral nephrectomy. During hemodialysis, blood was exposed to NIR radiation in half of the animals during extracorporeal circulation. Conducting 100 hemodialysis treatments allowed for statistical analyzes necessary to obtain the results for the tested parameters.

My research has shown that the method used to test the fluidity of the platelet membrane shows correlations with the state of activity and is useful in assessing its changes caused by hemodialysis. The experiments carried out showed that irradiation with NIR radiation led to a reduction in platelets activation, which were characterized by a greater aggregation capacity. An observable effect of the use of near-infrared radiation was a significant reduction in the formation of thrombi on the surface of the dialyzer membrane, which indicates the inhibition of activation processes.

The experimental results confirmed the hypothesis put forward in this dissertation that near-infrared radiation has a protective effect on platelets during extracorporeal circulation in hemodialysis.

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