erythrocyte membranes in diabetes mellitus type I patients were hyperpolarized, showing the membrane potential equal to (-14.8 ±1.9) mV (n=16). This difference is due to constant oxidative stress in red blood cells during diabetes.

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MELATONIN DIMINISHES OXIDATIVE STRESS IN PLASMA AFTER LOW DOSE LIPOPOLYSACCHARIDE EXPOSURE IN MICE

Kurhaluk Natalia, Tkachenko Halyna

Institute of Biology and Earth Sciences, Pomeranian University in Słupsk, Poland

Introduction. The principal components of the outer membrane of Gram-negative bacteria are lipopolysaccharides (LPS), also termed endotoxins, which initiate inflammatory-induced immune responses (Guha and Mackman, 2001). LPS induces inflammatory cytokine release, including interleukin IL-6, IL-1β, and tumor necrosis factor α *via* toll-like receptor 4 binding, activating the signalling pathways of mitogen-activated protein kinases (MAPKs), including extracellular signal-related kinase 1/2, p38MAPK, c-Jun NH_2-terminal kinase and nuclear factor kappa-light-chain-enhancer of activated B cells (NF-κB), have been demonstrated to be involved in LPS-induced inflammatory responses (Chan and Riches, 2001; Qi et al., 2013; Cochet and Peri, 2017).

The spectrum of physiological effects caused by melatonin is quite wide (Melchiorri et al. 1995; Escames et al. 1997; von Gall et al. 2002; Kurhaluk and Tkachenko, 2020; Kurhaluk et al., 2020, 2021). The action of this substance is observed at the systemic, tissue, cellular and subcellular levels (Saravanan et al. 2007). Melatonin reduces both basal and bacterial LPS-induced lipid peroxidation in vitro, as was shown by Sewerynek et al. (1995). Melatonin inhibited LPS-induced inflammation and oxidative stress in cultured mouse mammary tissue. It might contribute to mastitis therapy while treating antibiotic resistance (Shao et al., 2015;

Yu and Tan, 2019). The protective effects of melatonin on LPS-induced testicular nitro-oxidative stress, inflammation, and associated damages in the testes of male golden hamsters, *Mesocricetus auratus*, were revealed by Kumar and co-workers (2021). Melatonin can alleviate LPS-induced myocardial injury, providing novel insights into the treatment of sepsis-induced myocardial dysfunction (Su et al., 2021). Pretreatment with melatonin significantly increases antioxidant activities and decreases lipoperoxidation and oxidative protein levels in selected tissues and blood. These results indicate that the significant protective activity of melatonin on oxidative stress and morphological blood parameters induced by LPS might be associated with the antioxidant activity of melatonin. The present study evaluated the effects of melatonin on the LPS-induced response using biomarkers of lipid peroxidation in the plasma of male white Balb/c mice.

Materials and methods. All experiments were performed between 10:00 a.m. and 12:00 p.m. to compensate for the circadian rhythm. Healthy male white Balb/c mice (*Mus musculus*), weighing about 20–30 g and aged about 2–3 months, were used in the experiments. The data were collected from 24 adult animals divided into four groups. The mice were housed at a constant temperature of 20 ± 2°C. The animals had free access to food and water throughout the experiments. The experiments were performed in accordance with the Guidelines of the European Union Council and the current laws and approved by the Ethical Commission (2612/2016).

The mice were randomly assigned into four groups: untreated controls (n = 6), melatonin-treated (n = 6), LPS-treated (n = 6) and LPS + melatonin-treated (n = 6). Melatonin was given as a daily intraperitoneal injection at a dose of 10 mg/kg melatonin for 10 days. Melatonin was dissolved in a minimum volume of ethanol and diluted in 0.9% NaCl to yield a dose of 10 mg/kg body weight, as described in previous studies (Bonnefont-Rousselot and Collin, 2010). LPS (*E. coli* serotype 026:B6, Sigma-Aldrich Sp. z.o.o, Poznan, Poland) was injected once intraperitoneally in a 150 μg dose per mouse. Control mice were given 0.9% NaCl intraperitoneally.

Blood samples (3 mL) were collected from a single mouse into tubes containing K_3-EDTA. After centrifugation, plasma samples were removed and frozen at –20°C and stored until analysis. The level of conjugated dienes was determined according to Kamyshnikov (2004). Conjugated dienes groups were determined at absorption peak at the wavelength of 233 nm and expressed in nmol per milligram of protein. 2-Thiobarbituric acid reactive substances (TBARS) were estimated using the method of Kamyshnikov (2004). TBARS levels were expressed in nmol of malondialdehyde (MDA) per milliliter of plasma.

All variables were tested for a normal distribution using the Kolmogorov-Smirnov and Lilliefors tests ($p > 0.05$) and the homogeneity of variance was checked using Levene's test. The significance of differences in the level of lipid peroxidation between the control and experimental groups was examined using one-way analysis of variance (ANOVA) and Bonferonni's post-hoc test. All statistical calculations were performed on separate data from each individual with Statistica 8.0 software (StatSoft Inc., Poland).

Results and conclusions. LPS administration was associated with the free radical oxidation of lipids. As this process occurs in several stages, we decided to assess the degree of change in levels of biomarkers at the beginning and the end of the lipid peroxidation process (LPO). Diene conjugation is considered to be a primary product following the formation of diene conjugates and ketodienes. Consequently, we estimated the initial substrate accumulation in this stage of free radical oxidation in plasma. After LPS treatment, the concentration of conjugated dienes was significantly higher ($F = 16.94$, $p = 0.000$) compared to those observed in control mice. Melatonin statistically decreased the concentration of conjugated dienes in plasma compared to LPS-treated mice. The concentration of MDA, i.e. the end product of the terminal stages of free radical oxidation of lipids plasma was significantly higher in plasma in LPS-exposed mice compared to the control group ($F = 13.84$, $p = 0.000$). Melatonin treatment in LPS-exposed mice resulted in lower MDA concentrations.

Thus, the MDA concentration (the end product of lipid oxidation), as an oxidative stress marker, was elevated in the plasma of LPS-treated animals compared to the control group. We have shown that the beneficial effects of melatonin on the oxidative damage induced by low-dose LPS are present in the initial (diene conjugates) stages of the LPO process. Melatonin treatment provided to LPS-exposed animals decreased overall oxidative stress in plasma. Melatonin provides multilevel protection in animals exposed to low-dose LPS.

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BLOOD OXYGENATION PROBLEM IN NORMAL AND PATHOLOGICAL CONDITIONS OF THE CARDIOVASCULAR SYSTEM

Mazalkova Maria

Molloy College, New York, USA

Introduction. Ensuring scientific and technological progress in medicine is necessary to improve the quality of medical care for the population and is largely achieved through the activation and use of the intellectual potential of medical workers by developing scientific and technical solutions at the level of world novelty with their protection by patents for inventions.

In the process of studying and analyzing a large array of scientific publications on the research topic [1, 2, 3, 4] no reviews of patent information were identified, which is an important part of scientific and technical information, as it reflects the results of research and development work aimed at developing new or improving known methods, devices or substances with world novelty and protected by patents.

In addition, the high inventive potential of the teaching staff contributes to the formation of the international image of the institution of science and education.

Purpose of the study: to analyze the contribution of inventors from the countries of the world community to the blood oxygenation problem in normal and pathological conditions of the cardiovascular system.

It should be emphasized that blood oxygenation and tissue perfusion are important metrics that may be monitored for a patient in a clinical or surgical setting.