THE EFFECT OF PERIPHERAL SEROTONINE PATHWAY ON BONE BIOMECHANICAL PARAMETERS IN RATS WITH EXPERIMENTAL CHRONIC RENAL FAILURE

VI Środkowo Europejski Kongres Osteoporozy i Osteoartrozy oraz XVII Zjazd Polskiego Towarzystwa Osteoartrologii i Polskiej Fundacji Osteoporozy, Kraków 25-26.09.2015

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Key words: *serotonin, 5-hydroxyindole acetic acid, biomechanical testing*

Objectives. Serotonin (5-HT) is a neuropeptide, which plays an important role in bone metabolism. There are two types of serotonin, which exert antagonistic effects depending on its sites of synthesis. When serotonin is produced peripherally via duodenum cells, it acts as a hormone to inhibit bone formation. In contrast, when produced in the brain, this amine acts as a neurotransmitter enhancing bone formation and inhibition of bone resorption.

Aim. The aim of the study was to assess the impact of changes in peripheral 5HT and its metabolite – 5-hydroxyindoleacetic acid (5HIAA) concentrations on biomechanical parameters of the femur in rats with experimental chronic renal failure (CRF).

Material and methods. Forty one month-old Wistar male rats were randomly allocated into subtotal nephrectomy and sham operation. Blood samples and bones were collected one and three

months after surgery, respectively. The concentration of 5-HT and 5HIAA was determined using HPLC. Left femurs was dissected and stored until biomechanical testing. The biomechanical properties of the left femur were measured using three-point-bending test. The biomechanical properties were determined by following parameters: S= stiffness; F_y=yield load; dl(F_y)=displacement at the yield point; F_u=ultimate load; dl(F_u)=displacement at fracture; W=work to fracture; E=Young modulus, σ_y=yield stress and σ_u=ultimate stress.

Results. The results indicate a statistically significant increase in levels of serotonin and its metabolite 5HIAA in serum of rats with CRF compared to the corresponding control groups. After adjusting for body weight, we observed an increase following parameters: dl (F_u), W, stiffness and σ_y in CRF rats in comparison to control groups. Conversely, F_y was significantly reduced in the early stage of CRF compared to controls, however, its values increased with the development of disease. The positive correlation was between 5-HT and 5 HIAA levels, while these parameters were inversely related to bone stiffness. Both 5-HT and 5HIAA were positively associated with dl(F_u). Moreover, 5HIAA positively correlated with W, E, and σ_u, and the tendency to positive relationship was observed between 5-HT and σ_u.

Conclusions. As a consequence of CRF, the elevation in the peripheral serotonin pathway metabolites occur, which resulting in decreased bone stiffness. Simultaneously, 5-HT and particularly 5HIAA seem to have beneficial effect on bone plasticity and bone material properties.

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WPŁYW OBWODOWEGO UKŁADU SEROTONINERGICZNEGO NA PARAMETRY BIOMECHANICZNE KOŚCI SZCZURÓW Z EKSPERYMENTALNĄ PRZEWLEKŁĄ NIEWYDOLNOŚCIĄ NEREK

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***Słowa kluczowe**: serotonina, kwas 5-hydroksyindolooctowy, testy biomechaniczne*