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*The influence of solcoseryl and vincristine on the
mechanical strength of the femur shaft in young rats*

Wpływ solcoserylu i winkrystyny na wytrzymałość mechaniczną trzonu
kości udowej u młodych szczurów

Bone is a highly specialised kind of connective tissue having unique properties and playing mainly the supportive role. Biomechanical properties of bones depend on the regular histologic structure, biochemical structure and on organism homeostasis as well as to a large degree on genetic properties.

The principal aim of the present study was to test the mechanical strength of the femur in young rats in physiological conditions and after administration of drugs: vincristine, solcoseryl and both drugs together in the cycles which are repeated once, twice and three times. Maximal force necessary for breaking the bone exposed to pressure under static loads was adopted as a parameter characterising the strength of the bone.

MATERIAL AND METHODS

The study was carried out on the 60 young albino males of Wistar rats with body weight 125 - 135 g divided into 4 groups. Group I in which rats were treated with solcoseryl, group II in which rats were treated with solcoseryl and vincristine at the same time, group III in which rats were treated with vincristine. The control group received intraperitoneally 0.9% solution of NaCl. The studied substances were administered intraperitoneally once, twice and three times at the intervals of 144 hours (according to gamma phase of semiduration of vincristine) in such concentrations that the volume of the administered substances was 0.25 ml per 100 g of body weight. After 144 hours since the administration of the last dose of the drug the animals were decapitated, sectioned; the femur was prepared. Then strength tests were carried out with application of

INSTRON 4302 load tester and with additional equipment. The measuring head type 2518-804 was used in the working range 0-1 kN and the register type X-t for registering the course of force-deformation relationship. The prepared femur was located transversely in the most stable position on two supports and then the force was applied by means of a steel bar. The measurement was carried out until breaking of the bone. The measurements resulted in the force-deformation profile from which the value of breaking force could be read. The obtained numerical values of the measurement were statistically analysed. Each breaking force of the femur was characterised by arithmetic mean – M, standard deviation – SD, mean error of arithmetic mean - SE and variability coefficient - V.

RESULTS

The investigations carried out on young rats allowed for the evaluation of mechanical strength of the femur shaft under static loads after administration of solcoseryl and vincristine or both drugs simultaneously with considering their administration cycles. The analysis of the obtained results confirms that in the young rats the force needed for breaking the femoral bone in the group receiving solcoseryl increases gradually and ranges from 70.95 N – to 107.65 N. In the group of young rats receiving vincristine, the decrease of femoral bone strength to 59.62 N and then the increase to 74.09 N is observed. When both solcoseryl and vincristine are administered simultaneously there is a slight gradual increase in femur shaft strength from 76.34 N to 80.79 N. In the control groups it has been confirmed that with time the femoral bone strength increases to about 108 N.

DISCUSSION

Carrying out of strength tests of bones is very significant due to their important function in the functioning of motor system. The forces influencing the bone may play both positive role – activating of osteoblasts for bone formation (under the load condition) as well as negative role during intensive injuries leading to violation of the bone structure continuity. Additionally, establishing the way of change in mechanical strength of bones in various pathological conditions is an open case. The strength tests of bones had been dealt with in a purely physical aspect to establish such parameters as: the strength under various loading conditions (2, 4, 5), the module of stiffness (1). Many researchers in their works relate basic strength parameters with the macroscopic (3, 6) and microscopic (11, 12)

structure. Some authors, such as Wie and others (13) describe the influence of cyclophosphamide on the bone and confirm the decrease of resistance to bending of the metaphysial part of the shaft of the femur. Others (8) used metotrexat and adriamycine and did not notice any significant changes in strength parameters.

In the studied group of young rats which received solcoseryl a statistically significant increase of femur strength in spite of not defined point of solcoseryl reaction to bony tissue was observed. Supposedly solcoseryl intensifies the increase in the amount of the mineral and the synthesis as well as the transformation of collagen fibres (7). Basing on the experimental results we can assume that vincristine, being the cytostatic drug, reacts unfavourably to the strength of bony tissue in young organisms. Cytostatics are chemical therapy agents that influence young cells in the phase of growth. We can presume that the applied vincristine could have inhibitory effect on the processes of formation of young bony tissue by inhibiting creation of new osteoblastic cells. Simultaneous administration of solcoseryl and vincristine causes the increase in strength of the shaft of femur in relation to the group in which only vincristine was applied. And these differences are statistically significant. In compliance with Sołtysiak's and Jędrych's and co-workers (10) we can assume that solcoseryl alleviates cytotoxic effect of this drug on the bone without violating its anti-neoplastic activity.

CONCLUSIONS

1. In the group of young rats administration of solcoseryl causes statistically significant increase in the strength of femur shaft.
2. Vincristine causes a decrease in mechanical strength of the femur shaft.
3. Solcoseryl, when applied simultaneously with vincristine in the young rats, decreases their negative influence on the strength of femur shaft.

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STRESZCZENIE

Doświadczenia przeprowadzono na młodych szczurach szczepu Wistar, którym podawano solcoseryl, winkrystynę oraz solcoseryl i winkrystynę łącznie. Analiza statystyczna wyników badań wskazuje na to, że u szczurów młodych po podaniu solcoserylu wystąpił statystycznie istotny wzrost wytrzymałości trzonu kości udowej w stosunku do grup kontrolnych, natomiast w wypadku winkrystyny obserwowano istotny spadek wytrzymałości trzonu kości udowej. Łączne podawanie solcoserylu i winkrystyny spowodowało niewielki, lecz istotny statystycznie spadek wytrzymałości trzonu kości udowej w stosunku do grup kontrolnych.