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AN EXAMPLE OF STATISTICAL ANALYSIS OF RESULTS OBTAINED IN BIOLOGICAL EXPERIMENT

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Biological problem

Alumina is known as biocompatible bioceramic for bone tissue reconstruction [1]. On the other hand, it is well documented that aluminum can be easily deposited in bone, and may bc responsible for osteomalacia [2].

The aim of this study was to verify if intrabone implantation of alumina is accompanied by the enhance aluminium content in the rat femurs. Twenty femurs with alumina implants inside excised from ten rats 8 months after implantation and twelve femurs originated from control (untreated) group (six rats) were tested. Each bone was cut transversally across cortical part of diaphysis into four pieces, as illustrated below (Fig.1) and aluminum level was determined in each section separately in order to detect aluminium gradient.

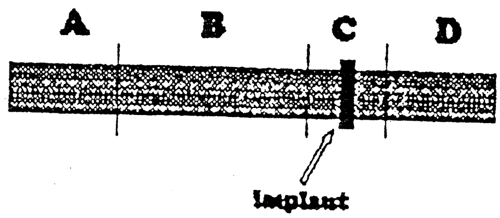

Fig.1. The scheme of bone cut into four pieces

Aluminum level was determined by means of atomic absorption spectroscopy [3]. In order not to count aluminium that could be a contaminant from the implant, pieces containing the implants were excluded from analysis. Therefore twenty values for each of three bone segments were obtained in the experimental group and twelve values of control aluminum level in each of analogous pieces of untreated femurs were acquired.

Statistical analysis

In order to treat two femurs of the same rat as a source of unconstrained samples, independence of pairs of results originating from the same animal (from the left and right femur) was tested by utilizing the Kendall test [4]. The hypothesis about dependence was rejected at a significance level of 0.05. The mean aluminium concentration in each of the analyzed bones ("u") was counted as follows:

$$u = (am_a + bm_b + dm_d)/(m_a + m_b + m_d)$$

where:

a,b,d	-	aluminum concentration in fragments "A", "B", "D" respectively (see Fig.1);
m_a, m_b, m_c	-	weights of the adequate femurs' fragments

The Wilcoxon test was used in order to compare the average aluminium concentration in the experimental bones and in the controls [4]. The Hodges-Lehmann estimator was calculated [4]. The statistical model, as follows was estimated: $X_i=e_i$; $Y_i=e_{12+j}+\delta$, where X_i and Y_i were the average aluminium concentrations in the experimental and control group respectively, and e_i, e_{12+j} were independent random variables (i=1,...,12; j=1,...20). The correctness of utilizing such a model was verified by the Moses test [4]. The hypothesis about the identify of mean aluminum concentrations in the experimental and the control bones ($Ho:\delta=0$) was rejected at a significance level of 0,0001. The alternative hypothesis about the major value of the mean aluminum concentration in the experimental bones ($H_1:\delta<0$) was accepted at the same significance level. The Hodges-Lehmann estimator was equal to 17,1 μg/g. Distribution of aluminium longwise the bone was analyzed by utilizing the Rank-Sum test. Both in the experimental and in the control group there was no foundation to reject the hypothesis about the uniform distribution of aluminium at a significance level of 0.02.

Results and conclusion

Aluminium content in the bone was significantly higher in femurs into which alumina rods were implanted as compared with control. The distribution of aluminium longwise the bone was uniform.

Intrabone implantation of alumina is accompanied by the enhance aluminum content in the rat femurs.

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