the tissues is achieved, and according to data in the literature [4], this is a favorable situation for spontaneous cleansing of the wound through the action of tissue hydrolases, against the background of a mild inflammatory reaction. Automatic control of the combined action of cold and heat rules out the possibility of tissue overheating in the zone of the wound canal. Meanwhile, if laser and plasma scalpels are used, tissue hyperthermia inevitably arises in the region of dissection, and this is evidently one of the main causes of local postoperative complications, leading to healing of wounds by secondary intention in 40% of cases [2].

The thermal characteristics of the MCC are responsible for its noncarcinogenicity and they enable the method of thermal dissection under cryoprotection to be used in operations for cancer.

On the basis of the results, the MCC can thus be regarded as a promising instrument for surgical operations on the brain and liver.

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MINERAL MATRIX PHOSPHATE EXCHANGE IN INTACT BONES AFTER SINGLE AND MULTIPLE FRACTURES

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KEY WORDS: mineral exchange; fracture; traumatic field

Phosphates are among the basic chemical components of the mineral matrix of bone tissue, and accordingly their determination in bone tissue reflects the degree of its mineralization [2]. After trauma the mineral content in bone tissue is reduced not only in the region of injury, but also in bones adjacent (intact) to the injured segment [4-7]. However, no detailed investigations of this problem have yet been undertaken.

The aim of this study was to establish the dynamics of changes in the phosphate content of the mineral matrix in intact bone tissue after single and multiple fractures of the long bones.

EXPERIMENTAL METHOD

Experiments were carried out on 122 male rats weighing 180-220 g, including 63 with a single fracture (of the middle third of the right femur), 51 with multiple fractures (middle third of both femora and both tibiae), and eight intact animals, which served as the control group. The method of producing a traumatic injury was described previously [1]. Phosphates in the mineral matrix were determined by Fiske and Subbarow's method [3]. Only the humeri were investigated in rats with multiple fractures. In rats with single fractures, besides the humeri, both tibiae and the left femur also were investigated. The animals were withdrawn from the experiment daily for 60 days after trauma, i.e., a time series was

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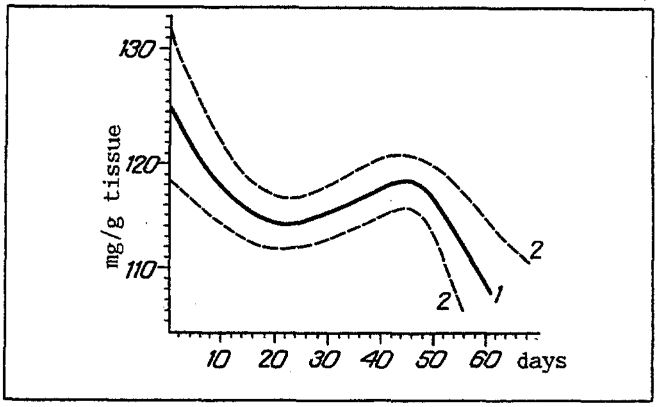

Fig. 1. Phosphate content in mineral matrix of right tibia after monotrauma. Curves: 1) average of distribution, 2) confidence interval.

TABLE 1. Correlation between Phosphate Content of Mineral Matrix of Right Tibia and Stages of Reparative Regeneration in Region of Fracture of Right Femur

Time, days	Phosphate content in bone	Stage of reparative regeneration and direction of exchange in mineral matrix
0—21	Reduced	Stage of resorption and formation of fibrocartilaginous callus (processes of resorption of mineral matrix predominate)
22—45	Increased	Stage of formation of bony callus (processes of mineralization, i.e., formation of the mineral matrix, predominate)
46—60	Reduced	Stages of remodeling of bony callus (processes of resorption of mineral matrix followed by reconstruction of bony tissue predominate)

obtained with period of observation from 1 to 60 days. The results were approximated by statistical mathematical models of the polynomial type. The data were processed by computer using specially developed programs.

EXPERIMENTAL RESULTS

The phosphate content of the mineral matrix after monotrauma in the left and right humeri, and also the left femur and left tibia remained unchanged throughout the period of investigation (120.4 ± 1.8, 119.7 ± 2.3, 121.0 ± 1.8, and 120.0 ± 1.5 mg/kg tissue respectively). No changes likewise were found in the left and right humeri after polytrauma (119.0 ± 2.5, 119.7 ± 1.8 mg/kg tissue respectively).

A completely different picture was observed when the phosphate content was studied in the intact right tibia after a fracture of the ipsilateral femur. The results were approximated by a polynomial of the type: $Y = A + BX + CX^2 + DX^3$ with the following parameters: $A = 126.1 \pm 7.4$, $B = -1.3 \pm 1.1$, $C = (4.7 \pm 4.4)\cdot 10^{-2}$, and $D = (5.1 \pm 4.8)\cdot 10^{-4}$.

It will be clear from Fig. 1 that the phosphate level fell starting with the 1st day and reached a minimum after 19-22 days, after which it rose, to reach a maximum after 37-45 days, which in turn was followed by a decrease in phosphate concentration until the 60th day. Incidentally, the initial decrease in the phosphate content corresponded in time to the periods of resorption and formation of fibrocartilaginous callus, i.e., to the time of activation of absorption of the mineral matrix. The period of an increase in the phosphate content corresponded to the period of construction of primary bony callus – the time of formation of mineral structures in the region of the fracture. The subsequent fall in phosphate content corresponded to the time of remodeling of the bony callus, i.e., to the period of activation of mineral absorption. The data are summarized in Table 1.

Thus in intact (adjacent to the site of fracture) bone tissue changes in mineral exchange similar to those taking place in the zone of trauma are observed. This is evidently connected with the particular features of the action of breakdown products, metabolites, signals, and so on, proceeding from the zone of injury into adjacent tissues and inducing the changes observed in them. The results are evidence that this phenomenon is local rather than generalized in character. This zone can best be distinguished and defined as the "traumatic field." The traumatic field is the region nearest to the injured area, in which no morphological changes are present but, at the same time, specific biochemical reactions for the repair process are found in the region of injury at the moment of investigation.

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MORPHOLOGICAL ANALYSIS OF THE ZINC-ACCUMULATING CAPACITY OF THE DIGESTIVE ORGANS

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KEY WORDS: zinc excess; accumulation; target organs

The current annual production of zinc amounts to millions of tons. Industrial pollution of agricultural products by this element is one of the main factors leading to its toxic action on man. If zinc enters the body in excess, the content of this metal in the pancreas may be increased by 35 times (for comparison, by 11 times in the liver) [6]. Meanwhile the acinar cells (AC) do not possess a developed lysosomal apparatus [4], in which metals entering the cells usually accumulate. It is also difficult to explain the unique zinc-accumulating capacity of the pancreas purely by stimulation of synthesis of metallothioneines in it [12]. Accordingly, in order to study the adaptive changes in organs of the digestive system creating conditions for deposition of a large quantity of zinc in them, a comparative analysis was undertaken of the time course of accumulation and compartmentalization of an excess of zinc in the pancreas, liver, and ileal mucosa (IM).

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