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RATE OF BONE SALT FORMATION IN A HEALING FRACTURE DETERMINED IN RATS BY MEANS OF RADIOPHOSPHORUS

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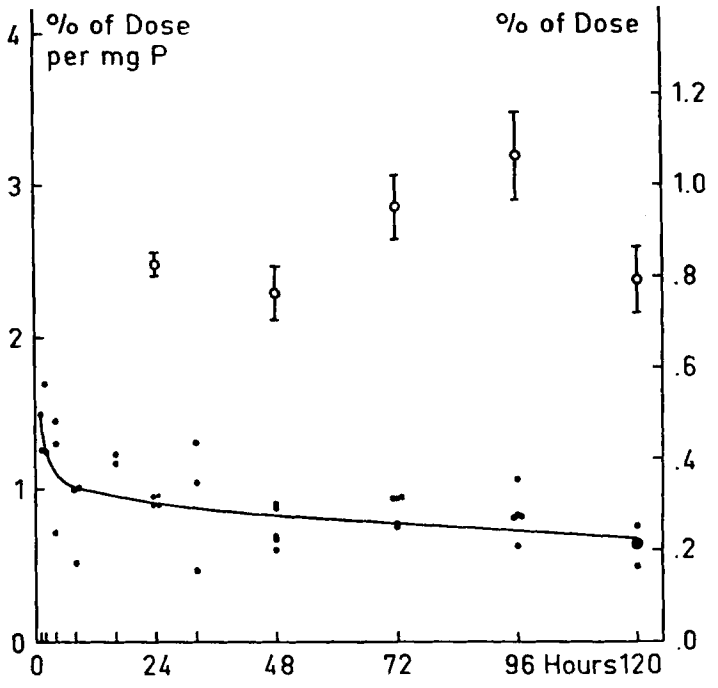
During the initial ten to fourteen days following a fracture in rats, the rate of bone salt formation in the fracture callus increases from day to day. Thereafter this rate gradually diminishes. In an earlier radiocalcium experiment (*Bauer,* 1954) it was found that the newly formed bone salt of the seven-day-old fracture callus is reached by a resorption process not earlier than about four to five days following its formation. In the present radiophosphorus experiment it is demonstrated that even in the fourteen-day-old fracture callus in rats, the newly formed bone salt stays unremoved during at least the initial four-day-period. The rate of formation of bone salt in the fracture callus can therefore be determined from the activity values.

EXPERIMENT

The series comprised thirty-seven mature male rats of an inbred strain. One femur in each animal was fractured manually in the mid portion of the shaft. Fourteen days following fracture, each rat received a subcutaneous injection of about 40 microC P^{32} containing a negligible quantity of phosphorus. The rats were killed by bleeding under ether anaestesia in groups of one to five at intervals after injection which ranged from one to 120 hours. The blood from each animal was collected, centrifuged, the serum was precipitated with trichloroacetic acid and again centrifuged. The clear residue was used for activity measurements and for colorimetric determinations of the phosphorus content. In each animal of the one- to five-Day groups, the fractured and the intact femur shafts were dissected free from adher-



Graph 1.

Specific Activity of the Serum Phosphorus and the Activity Values of the Fracture Callus at Varying Intervals of Time After the Administration of Radiophosphorus to Mature Rats with a Fourteen-Day-Old Fracture of One Femur Shaft.

Explanation of symbols:

- ● Specific activity of the serum P (plotted according to scale to the left of the graph). The individual values have been indicated in the graph.
- ○ Activity values (expressed in per cent of dose) of the fracture callus (scale to the right of the graph). The mean values are indicated in the graph ± the standard error.

ing soft tissue, care being taken not to remove the fracture callus. The activity of the bone shafts was determined on an acid solution of the bone ash, and by reference to a standard was expressed as per cent of dose administered. For details of technique, see *Bauer*, 1954; *Bauer* and *Carlsson*, 1955.

RESULTS

The activity of the fracture callus (recorded in graph 1) has been calculated by subtracting the activity recovered from the intact shafts from the activity of the fractured shafts (see *Bauer*, 1954). In graph 1 is also recorded the activity of the serum phosphorus. From these

TABLE 1

Rate of Bone Salt Formation[1] *in a Fourteen Day Old Fracture Callus in a Femur of Mature Rats.*

Interval of time after administration of the P^{32}	Average specific activity of the serum phosphorus (per cent of dose per mg P)[2]	Phosphorus uptake[3] (mg per hour) in the fracture callus	Number of animals
0 - 24 hours	.742	.046 (.0014)	5
0 - 48 „	.488	.032 (.0025)	5
0 - 72 „	.379	.035 (.0027)	5
0 - 96 „	.317	.035 (.0031)	5
0 120 „	.278	.024 (.0023)	5

(Figures in brackets = SE of the mean).

[1] Rate of bone salt formation has been expressed in terms of phosphorus uptake per hour.

[2] The average specific activity of the serum phosphorus has been calculated from the values of graph 1.

[3] The phosphorus uptake has been calculated from the specific activity values of the serum phosphorus in this table and the callus activity of graph 1 by means of the "U-formula" (see *Bauer*, 1954, page 180).

values the rate of phosphorus deposition in the fracture callus has been calculated according to the method described by *Carlsson*, 1952; *Bauer*, 1954. It is seen (table 1) that the two- to four-Day value is about 0.035 mg P per hour. With a Ca/P ratio of 2:1 in the bone salt, this figure corresponds to a deposition rate of calcium in the fourteen-day-old fracture callus of 0.07 mg per hour. This figure is in agreement with the earlier investigation.

The one-Day value is higher than the subsequent two- to four-Day plateau value, probably because the "exchange" mechanism accounts for a significant part of the activity recovered from the shafts at this early interval, see *Bauer* and *Carlsson*, 1955; *Bauer, Carlsson* and *Lindquist*, 1955.

Table 1 further demonstrates that the five-Day value is lower than the earlier values. This is probably due to the resorption of some of the newly formed bone salt of the fracture callus.

SUMMARY

Two weeks after fracture of one femur in rats the rate of deposition of phosphorus in the fracture callus has been determined from radiophosphorus data.

RESUME

Deux semaines après la fracture d'un fémur chez les rats, le taux du dépôt de phosphore dans le cal de la fracture a été déterminé par les données radio-phosphoriques.

ZUSAMMENFASSUNG

Zwei Wochen nach Bruch eines Oberschenkelknochens der Ratte ist die Grösse der Phosphoraufspeicherung im Bruchkallus mittels Radiumphosphor bestimmt worden.

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