Experimental Study on Bone of Parathyroidectomized Rats

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It is known that parathyroid hormone (PTH) is a potent regulatory factor in blood calcium level and bone metabolism, but the mechanism in which PTH influences bone metabolism is not quite clear. We conducted researches into the effect of parathyroidectomy and thyroid-parathyroidectomy on bone calcium metabolism and observed a significant reduction in serum calcium but no reduction in bone calcium in parathyroidectomized (PTX) rats. The thyroid-parathyroidectomized (TX-PTX) rats which received L-thyroxin (T_4) administration had higher bone calcium and trabecular bone than those without receiving T_4 supplementation, but neither could reach the normal.

MATERIALS AND METHODS

Female Wistar rats were randomly divided into 5 groups. The rats in one group were PTX, and the rats in other two groups were TX-PTX. 24 h later serum calcium level was measured. When fasting serum calcium concentration in the animals operated on was less than 1.5 mmol/L, the operation was considered to be complete. The remaining two groups served as controls. The rats were fed standard rat chow (Altromin C 1000) and water ad libitum. Fasting blood samples were obtained from all experimental animals after 7 weeks. The serum was stored at −20℃ until analysis. The tibiae were prepared for morphological analysis, and the femurs were used for physical analysis.

RESULTS

The results are shown in table 1. We observed a significant reduction in serum calcium in PTX rats (group E), but the bone calcium content and trabecular bone showed no decrease in comparison with the intact control (group A). TX-PTX rats which were supplied with T_4 had slightly higher bone calcium content and trabecular bone than those which were not, but the difference was of no statistical significance. The rats receiving sham operation had normal serum calcium and bone calcium content and trabecular bone (table 1).

DISCUSSION

Parathyroid hormone is a potent hormone for regulating blood calcium level. The major actions of PTH are on bone, intestine and kidney. In the

Table 1. Results of blood biochemistry tibia histology and femur physics ($\bar{x} \pm s\bar{x}$)

Groups (n)	Serum		Serum calcium	Tibia trabecular bone (%)	Femur		
	T_3 (mg/L)	T_4	at beginning at finish (mmol/L)		X-ray (pixel)	ash weight (mg/ml)	calcium (mg/ml)
A. Control (9)	0.65±0.1	53±14.3	2.67±0.2 2.48±0.1	22.1±4.5	6048±675	750±27	226±17
B. Sham OP (7)	0.77±0.2	74±17.1$^{\triangle\triangle}$	2.58±0.1 2.53±0.1	21.5±2.9	6007±229	726±54	223±15
C. TX-PTX (9)	0.40±0.1$^{\triangle\triangle}$	25±14.3$^{\triangle\triangle}$	1.14±0.2$^{\triangle\triangle}$ 1.30±0.3$^{\triangle\triangle}$	15.1±4.4$^{\triangle\triangle}$	3921±1255$^{\triangle\triangle}$	661±46$^{\triangle\triangle}$	197±12$^{\triangle\triangle}$
D. TX-PTX (7)	0.64±0.1	88±17.5$^{\triangle\triangle}$	1.08±0.1$^{\triangle\triangle}$ 1.10±0.2$^{\triangle\triangle}$	17.9±1.6$^{\triangle}$	5235±528$^{\triangle}$	669±58$^{\triangle\triangle}$	206±10$^{\triangle\triangle}$
E.PTX (9)	0.69±0.2	86±15.7	1.08±0.1$^{\triangle\triangle}$ 1.20±0.2$^{\triangle\triangle}$	24.6±5.7**	5789±753*	735±56*	222±10*

$^{\triangle}P<0.05$, $^{\triangle\triangle}P<0.01$, Significantly different versus group A
$^{*}P<0.05$, $^{**}P<0.01$, Significantly different versus group D

present study the rats in the groups C, D and E were PTX or TX-PTX, and their serum calcium levels could not be maintained in course of the experiment because of no or too little secretion of PTH. In physiological stages, the bone metabolism is in kinetic equilibrium between bone formation and resorption. In children or youth bone formation domintes, while in adults bone formation and resorption are kept in balance. But the ability of bone formation decreases with age after about 40 years. It is believed that the decrease of bone formation after middle age may be related to increased production of PTH.

The mechanism in which PTH acts on bone is still not understood. But its major effect on bone is increase of bone resorption by augmenting the activity and number of osteoclasts. Since osteoclasts do not appear to have receptors for PTH, this action is likely to be indirect.

Our observation demonstrated that the above-mentioned regulatory pattern of PTH to bone metabolism may be accepted. Group E was PTX and so had a lower serum calcium level than the control, but there was no difference between both groups in bone calcium content. Despite parathyroidectomy, bone mass was not obviously influenced. Possibly, this was due to the lack of stimulation of PTH on the osteoclastic process. Minne also reported that parathyroidectomy alone had no decreasing effect on bone mass[1]. It was also reported that diseases such as hypoparathyroidism may retard bone loss[2].

REFERENCES

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