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SERUM CALCIUM LEVELS IN THYROID-ABLATED RATS

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Radiolodine is used extensively to destroy the thyroid gland. Complete and permanent thyroid ablation can be achieved in rats with an I^{131} dosage of 3 to 4 $\mu\text{C/g}$ body weight (1). Microscopic examination of peritracheal remnants from rats injected with I^{131} at this dosage revealed only superficial alteration of the intimately associated parathyroid glands, and for this reason the parathyroids have been presumed to be functional. At very high levels of I^{131} administration, however, enough of the energetic beta radiation penetrates the parathyroid glands to effect their almost complete destruction (2).

In a study of the comparative reproductive capacities of female rats whose thyroid glands had been destroyed with 5 $\mu\text{C/g}$ of I^{131} and rats whose thyroid and parathyroid glands had been removed surgically (3), it was brought to our attention that parathyroid deficiency might seriously affect the experimental results (4, 5).

McLean and Urist (6) point out that the parathyroid glands are of major importance in the maintenance of a normal blood calcium level. In the absence of the parathyroid glands, the plasma calcium may fall 30% or more below normal. The calcium level in plasma should therefore be a

good measure of the functional status of the parathyroid glands.

These studies compare the serum calcium levels of rats whose thyroids had been destroyed by low and high dosages of I^{131} beta radiation, with those in surgically thyro-parathyroidectomized rats.

The animals used were female Sprague-Dawley rats obtained from the original colony. They were housed in metal cages on wood shavings and were fed Purina Laboratory Chow and tap water ad lib.

When the animals were 60 to 80 days old, 12 were surgically thyro-parathyroidectomized, six were given I^{131} intramuscularly at a level of $5 \mu C I^{131}$ per gram body weight (1, 3, 7), 16 rats were given I^{131} intravenously at a level of 50 to 90 $\mu C/g$, and 12 normal rats of varying ages served as controls.

Sixty or more days after treatment (see Table 1 for exact age at sacrifice) the animals were anesthetized with ether and a 6-ml blood sample was drawn into a heparinized syringe from the inferior vena cava. The red cells were separated from the plasma by centrifugation, and plasma calcium was measured in duplicate 1-ml samples by the method of Rehell (8). When present, thyroid and (or)

parathyroid remnants were dissected and fixed in Bouin's fluid. Paraffin embedded sections were cut at 6 μ and stained with hematoxylin and eosin.

The serum calcium levels of the various groups are shown in Table 1. No significant difference was found between eight control rats 143 days old and four controls 443 days old, therefore the data for these groups have been combined. Rats that received I^{131} at a level of 50 μ C/g had serum calcium levels identical to those given 90 μ C/g of I^{131} , therefore these groups also have been combined. As shown in the table the animals whose parathyroid glands had been removed surgically and those whose parathyroids had been destroyed by a very large amount of I^{131} had plasma calcium levels 22% below the normal mean. On the other hand, the low-level I^{131} -treated rats whose thyroid glands had been completely ablated, as shown in Fig. 1 (see also ref. 1), had a mean serum calcium level that differed only slightly from that of intact rats. For comparison the extent of parathyroid destruction following a massive dose of I^{131} is shown in Fig. 2.

These results indicate that I^{131} can be used to effect complete destruction of the thyroid glands without serious

impairment of the capacity of the parathyroid glands to maintain a normal plasma calcium level.

References and Notes

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7. I^{131} was obtained from Oak Ridge National Laboratory, and was administered in a basic solution of Na_2SO_3 .
8. B. Rehell, Scand. J. Clin. Lab. Invest. 6, 335 (1954).
9. This work was carried out under the auspices of the U.S. Atomic Energy Commission.

10. R. A. Fisher, Statistical Methods for Research Workers (Hafner Publishing Company, Inc., New York, 1954) 12th Edition.

TABLE 1

Serum calcium levels of I^{131} thyroid ablated rats and surgically thyro-parathyroidectomized rats.

Treatment Group	Rats			Serum Ca^{++} (mg/100 ml \pm S.E.)
	Number	Age (days)	Wt. (g)	
Control	12	143	292	9.84 \pm 0.11
		to	443	
Surgery	12	472	259	<u>7.86 \pm 0.21</u>
I^{131} 5 μ C/g	6	143	278	9.30 \pm 0.02
I^{131} > 50 μ C/g	16	300	185	<u>7.91 \pm 0.29</u>
		to	400	

Underlined means were compared to the control mean by the t-test of Fisher (10) and the P-value was beyond the 1% level of confidence.

FIGURE 1

Tracheal remnant from a rat 10 months after receiving 10 $\mu\text{C/g}$ of I^{131} . Note absence of any thyroid tissue and almost intact appearance of parathyroid. H and E, $\times 50$.

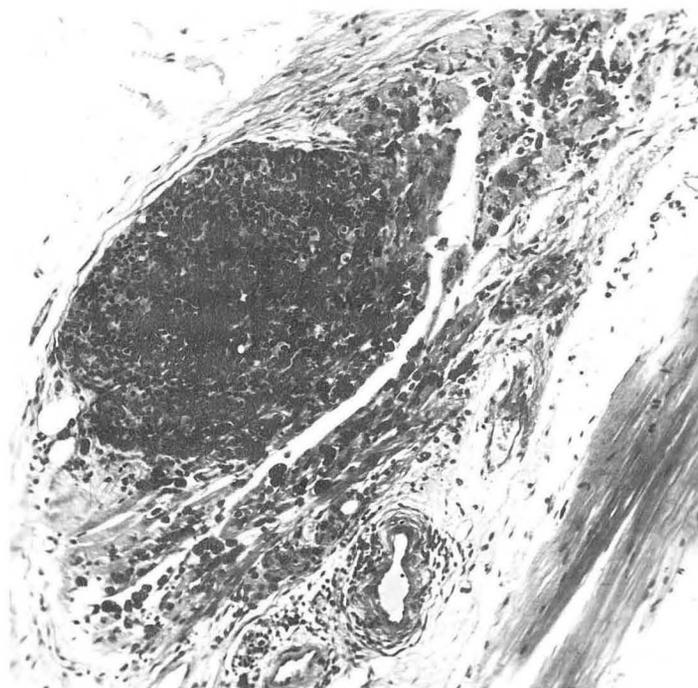


FIGURE 2

Tracheal remnants from a rat 12 months after receiving 50 $\mu\text{C/g}$ of I^{131} . Note "burned-out" appearance of thyroid tissue and marked fibrous replacement of parathyroid tissue.* H and E, $\times 60$.

*Peritracheal tissue uptake of a tracer dose of I^{131} 24 hours before sacrifice of this animal was 0.02%.

