UNITED STATES ATOMIC ENERGY COMMISSION

NYO-1544

THE MOUSE THYROID AND RADIOACTIVE IODINE (I^{131})
1. GENERAL MORPHOLOGY OF THYROID GLAND

By
Roberts Rugh

March 1, 1951

Columbia University

Technical Information Service, Oak Ridge, Tennessee

2

BIOLOGY

Reproduced direct from copy
as submitted to this office.

Work performed under
Contract No. AT-30-1-gen-70

AEC, Oak Ridge, Tenn., 4-2-51--335--W-3152

THE MOUSE THYROID AND RADIOACTIVE IODINE (I^{131})

1. GENERAL MORPHOLOGY OF THYROID GLAND

by Roberts Rugh

ABSTRACT

This is the first in a series of papers dealing with the effect of carrier-free Na I^{131} on the adult nursing and non-nursing mouse, and also on the litter young. The emphasis is on the effect of lactation on the distribution of radioiodine and the consequent alteration of the expected histopathological effects.

In this brief introductory paper a detailed morphological analysis is made of the thyroid gland itself, the data of which are important in explaining the histopathological effects on various parts of the gland. It is shown that in the adult the gland weighs approximately 4 mg., has an average (lobe) length of 1500 μ, lobe width of 600 μ, and lobe thickness of 900 μ. The isthmus measures an average of 1300 μ between the lobes, 400 μ from anterior to posterior and 100 μ from front to back. There is radioautographic evidence that the gland is functional at birth.

I. General Morphology of Thyroid Gland

This is the first of a series of papers which will deal extensively with the effect of radioactive iodine (I^{131}) on the mouse, both the adult female and its suckling young. Since the thyroid gland is known to have a strong avidity for iodine, this gland will be the center of interest throughout the series although a total of 11 tissues and the residual carcass will also be analyzed. The study includes the excretion rate; the tissue distribution; and the histopathology of both the thyroid and the pituitary glands in both the mother and her suckling young, at various intervals after the mothers are given single injections of varying doses of carrier-free Na I^{131}.

The increasing use of radioactive iodine in the treatment of hyperthyroidism and in certain types of thyroid cancer has made the accurate determination of the morphology of the thyroid gland of prime importance. Since the mouse is used extensively in these and in related research programs, the following description will be particularly applicable to the thyroid glands of the common Swiss strain of white mice. There is, of course, no presumption of similarity of the human thyroid.

The Thyroid Gland of the Newborn Mouse. The thyroid gland of the mouse begins the elaboration of its hormone several days before birth (Plate I, Fig. 9) but at this time there are no typical follicles and hence no follicular colloid. Nevertheless

there is iodine uptake by the gland sometime before 19 days, as indicated by radioautographs. The first appearance of the thyroid colloid within the follicles occurs about 3 to 4 days after birth (Plate I, Fig. 3 and 10). This colloid arises in scattered follicles throughout the central region of the gland. Radioautographs following I^{131} treatment of the mother, and thence the suckling newborn mouse, indicates an even or homogeneous distribution of the iodine (Plate I, Fig. 4). There is no perceptible concentration of radioactivity such as one would expect from follicular colloid secretion, or as one does find in the adult thyroid. This is true even of the short-exposure radioautographs.

The general morphology of the thyroid gland shortly after the birth of the mouse is quite similar to that of the adult mouse, but on a smaller scale. The two lobes are essentially alike, measuring about 900 μ in anterior-posterior length, and from 375 to 400 μ in width (from left to right). The thickness (from front to back) is generally slightly greater, measuring from 550 to 600 μ. These dimensions are considerably smaller, but in proportion, to those of the adult mouse.

The 2 month old mouse has a thyroid gland almost indistinguishable from the sexually active adult. The thyroid isthmus or band which joins the two lobes at their posterior limits is also small. It measures a maximum of 220 μ in anterior-posterior direction or width, about 60 μ in thickness (from front to back).

Its length, right to left, is about 1200 μ. This band shows little if any radioactivity when the young mouse is treated with I^{131} as determined by radioautographs. This is probably due in part to the very low concentration in it of radioiodine. This portion of the gland of the newborn mouse thyroid is slow to elaborate the colloid and the hormone.

The parathyroid glands of the mouse vary in size, position, and in number, although there is generally but a single pair. In the newborn mouse they are often embedded within the thyroid tissue, lateral and anterior within each of the lobes. The glands are almost spherical measuring from 150 to 200 μ in any direction. The maximum dimension is generally its thickness, from front to back. Occasionally a parathyroid may be partially lobed, extensively lobed, or separated into two or more lobes. In probably 90% of the snimals examined, there was but a single pair of parathyroids, essentially alike in size, shape, and in position with respect to the thyroid lobe. In close proximity to the parathyroids was often found a large branch of the thyroid vein.

Thyroid Gland of the Adult Mouse. The thyroid gland of the adult mouse (which may weigh a total of from 26 to 30 g.) will weigh only 3.6 to 4.0 mg when dissected away from the adjacent laryngeal cartilage and muscle. Its dimensions are shown in the following table, with the range in all animals studied indicated in parentheses. The shape of the thyroid of the mouse as found

in s itu is shown both in the photographs (Plate I, Fig. 1 and 2) and in the accompanying drawing (Plate II). The drawing, from ventral and from lateral view, represents a composite of gross measurements and of reconstruction from serial sections. In the photograph of the whole gland (Plate I, Fig. 2) the follicles are easily visible. One parathyroid, to the left of the animal, is largely obscured by the thyroid itself.

Radioautographs of sections of the whole thyroid (Plate I, Figs. 5 and 6) of the adult mouse indicate activity throughout, including the thin (isthmus) band. They also indicate follicular concentration of the I^{131}. The slides were stained with Masson trichrome stain, and there was no correlation betwwen the color of the colloid and the degree of radioactivity. In Plate I, Fig. 7 and 8 distinctly indicate the lack of uptake by the parathyroid gland.

In the radiobiological experiments to be reported in this series, emphasis will be placed on the fact that the thyroid of the adult mouse is extremely small; that at no place is it more than 1.2 mm. wide or thick; that the thyroid band (isthmus) is made up of the same material but is never more than 125 μ in thickness; and that the parathyroid glands are embedded within the thyroid tissue but remain functionally distinct.

SUMMARY. Histologic and radioautographic evidence support the thesis that the thyroid gland of the mouse is functional at birth, but in a diffuse manner as compared with its function in the adult. The gland at that time shows absorption

of I^{131} but there are few follicles and little colloid where the activity could be concentrated. The shape of the gland is typical of the adult but its maximum size is not attained for about 2 months. At this time its appearance and radiological activity is comparable to that of any adult mouse. The entire gland of the adult weighs about 4.0 mg. in a mouse weighing from 26 to 30 g. It measures an average of 1500 μ in length, 600 μ in width and 900 μ in thickness. The isthmus band which joins the two lobes at their posterior extremities, and is made up of thyroid tissue, measures about 1300 μ long (right to left), 400 μ wide (anterior-posterior), and 100 μ thick (from front to back).

In subsequent papers of this series, the information of this current report will be taken as a basis for the discussion of the experimental results presented.

TABLE 1

DIMENSIONS OF THE ADULT MOUSE THYROID*

	LENGTH (TOTAL) (Ant-Post)	WIDTH OF LOBE (Left-Right)	THICKNESS OF LOBE (Front-Back)
THYROID	1500 μ (1300-1800)	600 μ (500-1000)	900 μ (800-1200)
THYROID BAND	400 μ (300-700)	1300 μ (1200-1500)	100 μ (90-125)
PARATHYROID	300 μ (150-420)	250 μ (100-400)	250 μ (125-300)

*Data taken from serial sections of 14 normal thyroids from adult female mice. Averages taken to nearest 25 μ

PLATE 1

Mouse Thyroids

Fig. 1 - Entire thyroid and parathyroids of adult female mouse, in normal relation to other organs. Outlined in India ink. Parathyroid to right obscured by thyroid.

Fig. 2 - Same as Fig. 1 except not outlined with ink. Note follicles even in living thyroid.

Fig. 3 - Transverse section through thyroid of three day old mouse.

Fig. 4 - Radioautograph of section shown in Fig. 3, made 24 hours after mother was injected with radioactive iodine (I^{131}). Note homogeneity of autograph.

Fig. 5 - Transverse section through thyroid of adult female mouse.

Fig. 6 - Radioautograph of section shown in Fig. 5, made 24 hours after the mouse received an injection of radioactive iodine (I^{131}). Note follicular concentration of activity.

Fig. 7 - Transverse section of one lobe of thyroid of adult female mouse, at the level of the parathyroid gland.

Fig. 8 - Radioautograph of section shown in Fig. 7, made 24 hours after the mouse received an injection of radioactive iodine (I^{131}). Note follicular distribution of activity, and entirely clear area corresponding to parathyroid.

Fig. 9 - Sagittal section of mouse fetus at 19 days, with superimposed radioautograph showing considerably activity in the region of the thyroid gland. (I^{131}).

Fig. 10- Sagittal section of newborn mouse at 3 days, with superimposed radioautograph showing exclusive activity in the region of the thyroid gland. (I^{131}).

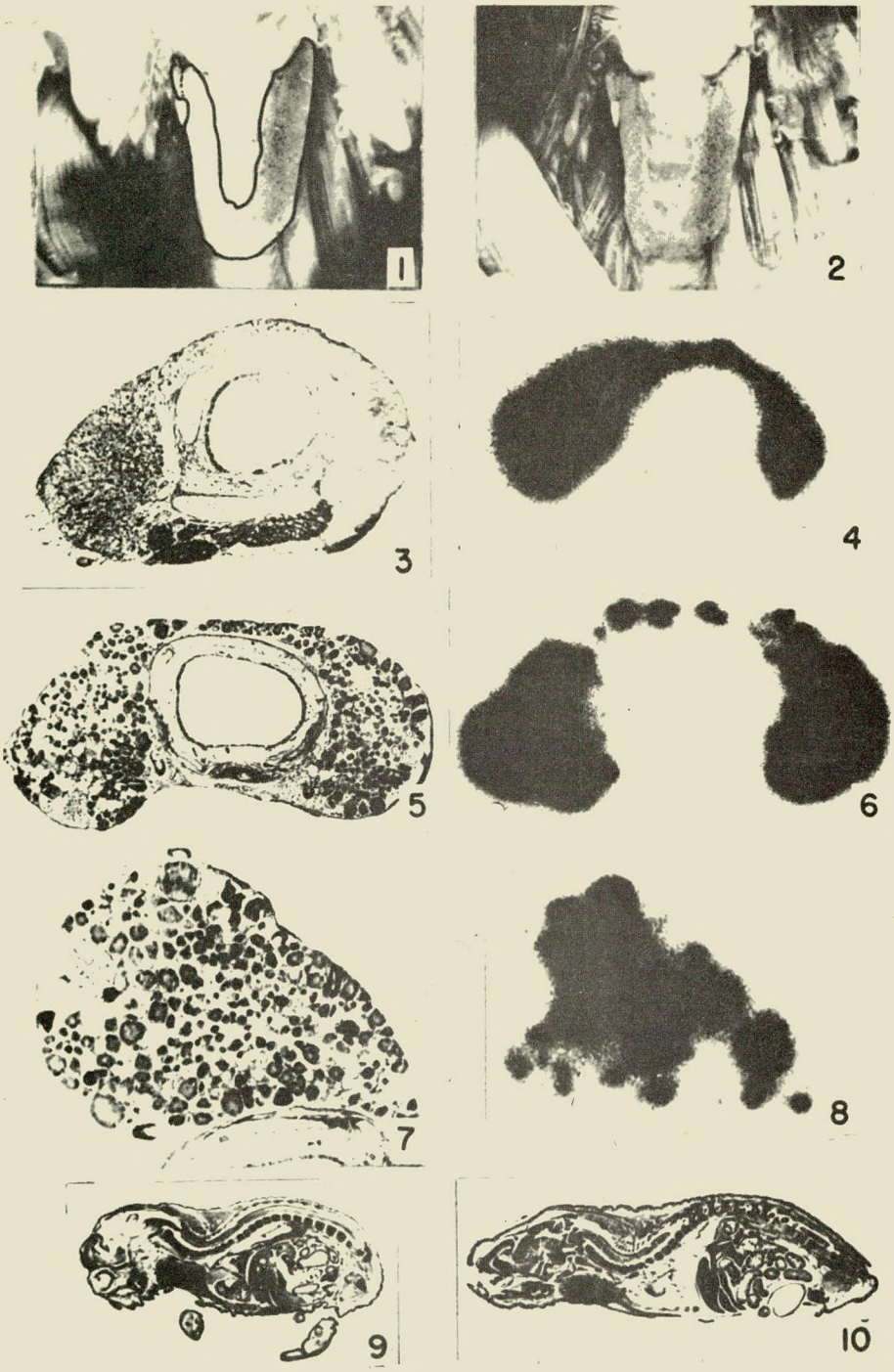
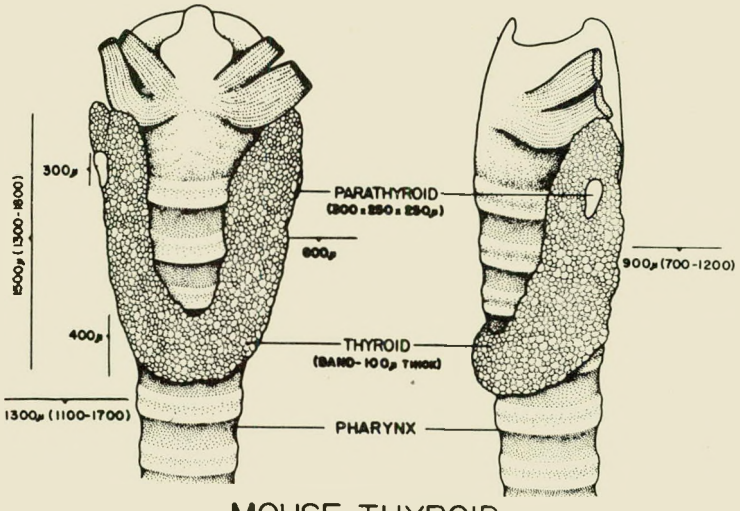


Plate I



MOUSE THYROID

Plate II

END OF DOCUMENT