A. Lupulescu and A. Petrovici Ultrastructure of the Thyroid Gland

Ultrastructure of the Thyroid Gland
A. Lupulescu, M.D.
Institute of Endocrinology, Bucharest (Rumania)
A. Petrovici, M.D.
'Dr. I. Cantacuzino' Institute, Bucharest (Rumania)
With 103 figures
S.Karger Basel (Switzerland) New York 1968
Originally published by S. Karger AG, Arnold-Bcklin-Strasse 25, 4000 Basel 11
(Switzerland)
Distributed simultaneously by
The Williams & Wilkins Company, Baltimore
in USA and Canada
Llwilliam Heinemann Medical Books Ltd., London
in Great Britain and the British Commonwealth
(excluding Canada)
All rights, including that of translation into other languages, reserved.
Photomechanic reproduction (photocopy, microcopy) of this book or part of it without
special permission of the publishers is prohibited.
Copyright 1968 by S. Karger AG, Basel
Book design by S. Karger / Thomas Duss
Printed in Switzerland by Buchdruckerei Rutter AG, Reinach BL
Blocks by Steiner & Co. AG, Basel
Binding by M. Grollimund AG, Basel
Index
Foreword VII
Acknowledgements VIII
Introduction 1
I. Ultrastructure of the Normal Thyroid Gland 4
1. Gross histology of the thyroid gland 4
2. Fine structure of the thyroid follicle 8
(a) Rat thyroid follicle 8
(b) Perifollicular capillaries 16
3. Variations in the ultrastructure of the thyroid gland in different animal species 19
4. The mechanism of synthesis and secretion of thyroid hormones 22
(a) Thyroglobulin synthesis 23
(b) Migration of thyroglobulins and their secretion into the follicular lumen 24
(c) Thyroglobulin iodination 25
(d) Colloid resorption 26
(e) Intracellular transport of iodinated thyroglobulin 27
Conclusions 30
References 31

I. Electron Microscopy of Goiter and Thyroid Tumors Induced by Iodine Deficiency 35
1. Goiter produced by iodine deficiency 36
   (a) Parenchymatous goiter 37
   (b) Colloid goiter 38
   (c) The degenerative-atrophic stage 39
2. The effects of acute and chronic administration of TSH to rats with goiter induced by iodine deficiency 40
   (a) Acute TSH administration to rats with goiter induced by iodine deficiency 40
   (b) The effect of chronic administration of TSH to rats with goiter induced by iodine deficiency 42
3. The ultrastructure of goiter induced by feeding with cabbage (cabbage-goiter) 43
4. The fine structure of thyroid tumors induced by iodine deficiency 44
5. Some considerations and conclusions concerning the cytophysiology of iodine-deficient thyroids 46
References 49

III. Ultrastructural Changes of the Thyroid Gland in Different Experimental Conditions 50
1. The effect of chronic administration of synthetic goitrogenic drugs (methylthiouracil - MTU) (methylthiouracil goiter) 50
2. The effect of acute administration of TSH 52
3. The effect of chronic TSH administration 54
4. Ultrastructural changes in rats after cold-exposure 55
5. Ultrastructures of the thyroid in hypophysectomized rats 56
6. The effect of chronic administration of triiodothyronine (3) 56
7. The effect of acute administration of thyroxine (Ta) 57
8. The effect of the administration of different iodine doses 57
9. Thyroid ultrastructural changes produced by the administration of potassium thiocyanate to rats 58
10. Ultrastructure of the thyroid in experimental autoimmune thyroiditis 59
11. Thyroid ultrastructural changes after irradiation with radioiodine (131I) 59
General considerations and conclusions 60
References 62

IV. Electron Microscopy of the Human Thyroid Gland 64
1. Graves-Basedow disease 65
2. Nodular (colloid) goiter 66
3. Simple goiter 67
4. Thyroid ultrastructural changes in endemic cretinism 69
5. The ultrastructure of the thyroid tumors 72
6. Ultrastructure of the thyroid in lymphocytic thyroiditis (Hashimoto's disease) 74
Discussion and conclusions 75
Foreword

During recent years a considerable amount of material concerning the physiology and biochemistry of the thyroid gland has accumulated. However, the findings in this field cannot be fully understood without a thorough knowledge of cellular phenomena.

Any normal or pathological biochemical phenomenon that takes place within the cellular organelles sooner or later produces some side effect upon the structure and particularly upon the ultrastructure of the cell. Hence, a balanced approach between morbid cytology and morbid biochemistry is necessary.

This monograph hopes to be useful both to research workers and to other interested readers in the sphere of histology and pathology of the thyroid gland. Apart from a study of the ultrastructure of the normal thyroid and of changes occurring in different experimental conditions, several further chapters have been introduced, such as those on the ultrastructure of iodine-deficient thyroids and of the human thyroid gland, and autoradiography by light and electron microscopy.

Similarly, the investigations include a study of the influence of certain drugs commonly used in the therapy of thyroid diseases, about whose action at infracellular level hardly anything is known.

An attempt has been made to correlate, as far as possible, the ultrastructural changes with the autoradiographic, the biochemical or the more recent radiochemical alterations.

Confronted with an ever-increasing and as yet partly contradictory mass of material, we feel that this volume brings new contributions to our understanding of the fascinating field of the biosynthesis of hormones.

Acknowledgements

Our sincere thanks are due to the editors of the Journal of Cell Biology (The Rockefeller University Press) for permission to reproduce from vol.25, no.3 (June, 1965) the original continuous tone photographs on pages 605
(Fig. 15) and 609 (Fig. 25) of the article on `Changes in Fine Structure and Acid Phosphatase Localization in Rat Thyroid Cells following Thyrotropin Administration' by B. WETZEL, S. SPICER and S. WOLLMAN.

We would also like to thank the editorial staff for their valuable help in the publication of this book.

Bucharest, July 1966

The authors