The influence of iodine and tri-iodo-thyronine on autoimmune thyroid thyroiditis and type 1 diabetes mellitus in rats and application of stereological tools on the thyroid gland of rats

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ABSTRACT

This PhD dissertation has been performed as a collaboration between Dept. of Endocrinology and Bartholin Instituttet, and Research Laboratory of Stereology and Neuroscience, University Hospital of Copenhagen.

The importance of the functional level of the thyroid gland and the beta cells in the development of autoimmune thyroiditis (AIT) and Type 1 diabetes mellitus (T1DM) respectively is addressed. Additionally unbiased stereological methods are applied to the thyroid gland.

The aim was to investigate whether changed thyroid activity by neonatal stimulation with iodine or thyroid stimulating hormone (TSH), or adolescent suppression of the thyroid gland by tri-iodothyronine (T_3), could change the incidence of AIT in bio breeding (BB) rats. As thyroid hormones are known to influence the metabolism in general including the pancreas and the insulin metabolism we also aimed to evaluate the influence of iodine, T_3 and TSH on the incidence of T1DM in BB rats. Finally we aimed to develop a set of assumption free methods to evaluate the morphology of the thyroid by estimating the volume of the thyroid gland and the colloid, the number of follicles, the size distribution of the follicles by determining the volume weighted mean volume of colloid and the inner follicular surface area.

Stimulation of the thyroid gland with iodine or early suppression by T_3 reduced the prevalence of AIT whereas T_3 given later increased the prevalence of AIT in rats. No influence of TSH was found.

The incidence of T1DM was diminished by treatment with iodine and T_3 whereas TSH did not prevent T1DM. Since T_3 was given in an important period of beta-cell maturation the influence of T_3 on the relative beta-cell mass was investigated in Wistar rats and found increased.

The presently developed stereological estimators of thyroid morphology have not been applied to the thyroid before. The number of follicles and the inner follicular surface area were associated to the total volume of colloid in each follicle. These findings indicate that an increased volume of colloid under physiological conditions in adult rats is associated with an increased number of follicles.

We conclude that the activity of the thyroid gland at different ages may be of importance for the development AIT. Iodine and T_3 given early in life reduced that incidence of T1DM and increased the relative beta-cell mass, which may be caused by a change in beta-cell activity or an influence of iodine and T_3 on the immune system. Further studies are needed to explain the mechanisms for these findings. A set of assumption-free methods has been applied to the thyroid gland and the presented methods are applicable to other purposes. The methods have given us a tool to further investigate the morphology of the thyroid gland under physiological and pathophysiological conditions.