The Perinatal Thyroid in Iodine Deficient Regions: Risks from Radioiodines - Hazards of Stable Iodine Overload

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An unexpectedly large increase in thyroid cancer occurred in children following the Chernobyl accident raising issues of public health concern. It is questioned whether iodine deficiency induces other deleterious effects apart from exacerbating thyroid uptake of radioactive iodine. Is prophylactic stable iodine-overload safe, and in particular, what are the effects in new-born infants?

These questions were investigated in the present study using iodine-deficient new-born rats. The microscopic distribution of radioiodines in the thyroid was studied using $^{129}$I as tracer and secondary ion mass spectrometry (SIMS). The effects of thyroid protection by means of iodine-overload were examined using light microscopy.

Three pregnant Wistar rats were fed an iodine-deficient diet (60µg/kg or <1µg/rat/day) in order to reproduce relative iodine deficiency such as that prevailing in the Chernoby l area prior to the accident and the new-born pups were assigned to the tracer, iodine overload and control groups. The tracer group consisted of twelve new-born rats from the first dam. They received 0.1µg of $^{129}$I subcutaneously on the second day of life. The iodine-overload group consisted of twelve new-born rats from the second dam. They received 100µg of $^{129}$I subcutaneously the second day of life. Ten new-born rats from the third iodine-deficient dam acted as controls. The thyroids of the animals were ecised 24h and 1 week after $^{129}$I administration. All thyroid tissues were prepared according to conventional methods used in electron microscopy. One µm thick serial thyroid sections were placed on glass slides for examination using light microscopy and on thin gold plates for examination using SIMS.

SIMS images showed large variations in $^{129}$I concentration and in $^{129}$I content from one thyroid follicle to another. Up to 24 hours post-administration, the distribution of $^{129}$I within the colloid was heterogeneous and greatest at the periphery closest to the thyroid cells. "Protected" thyroids showed unexpected signs of acute toxicity including marked desquamation of epithelial cells and follicle rupture.

It is concluded that dosimetric models, assuming uniform iodine uptake by thyroid follicles, are invalid under conditions of iodine deficiency which induces patchy irradiation. The distribution of incorporated iodine close to the thyroid cells, in the first hours, suggests that the often neglected short-lived radioiodines are particularly harmful. Furthermore, stable iodine-overload may have toxic effects on in-utero and new-born infants.