The Influence of Environmental Toxins on Thyroid Function

There are a number of environmental agents that have been identified as having an adverse affect on the thyroid gland; some of which have been specifically identified; while others are considered suspect and are not yet distinguished. The agents discussed in this article are among those that have been precisely identified.

The Hypothalamus-Pituitary-Thyroid axis is a target of endocrine disrupting chemicals, in particular, polyhalogenated phenolic compounds such as polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs), probably because of their structural resemblance to thyroid hormones. These chemicals may cause disturbance of thyroid homeostasis, hypothyroidism, thyroid hyperplasia, and neoplasia.\(^1\) It appears that endocrine disrupting chemicals interferes on several levels of the HPT axis.\(^1\) These interferences appear not to conform to classic mechanism of endocrine regulation and feedback.\(^1\) It is possible that one compound may affect several levels of the HPT axis further complicating the situation. An example of this is genistein, one of the isoflavones. Genistein can inhibit TPO enzyme activity; inhibit thyroid hormone binding to transthyretin; and display estrogenic and anti-estrogenic effects by interacting with estrogen receptors.\(^1\)

### Mechanisms of Chemical Disruption on Thyroid Function

Iodine is essential for thyroid hormone synthesis. Iodide enters the thyroid follicular cells via the sodium iodide symporter (NIS). Certain chemicals can interfere with the NIS causing a decrease of iodide uptake. The main chemicals of concern are; perchlorates (\(\text{CLO}_4^-\)), thiocyanate (\(\text{SCN}^-\)), and nitrate (\(\text{NO}_3^-\)). Thiocyanate in blood may originate from tobacco smoking, from industrial pollution of the environment, or from ingestion of certain foods.\(^2\) Perchlorate is both a naturally occurring and manmade contaminant increasingly found in groundwater, surface water and soil. Most perchlorate manufactured in the U.S. is used as an ingredient in solid fuel for rockets and missiles. In addition, perchlorate-based chemicals are also used in the construction of highway safety flares, fireworks, pyrotechnics, explosives, common batteries, and automobile restraint systems.\(^3\) Because of the environmental stability of perchlorate, it has become a widespread contaminant in drinking water and irrigation waters and in food, such that perchlorate contamination is nearly ubiquitous in the U.S. population.\(^4\) Much focus has been placed on the impact of exposure to perchlorate (\(\text{CLO}_4^-\)) from drinking water. Recently, it has become more apparent that a significant percentage of the total \(\text{CLO}_4^-\) exposure may be due to ingestion of food.\(^5\)
The organification of iodine, that is the adding of iodine to the tyrosine, is orchestrated by the enzyme thyroid peroxidase (TPO). It important to keep in mind that TPO is a heme-contain enzyme and therefore can be affected by an iron deficient state. Several substances are known to inhibit TPO, which include, 6-propyl-2-thiouracil (used to treat Graves disease) and isoflavones (e.g. genistein and coumesterol).\textsuperscript{4} Isoflavones are polyphenolic compounds that are capable of exerting estrogen-like effects, as well as inhibiting TPO. Since soy products contain a significant amount of isoflavones, one must question the efficacy of using soy-based infant formula.

It is apparent that research is proving how environmental toxins can have an adverse affect on thyroid function. It is my hope that identification of toxins and their effects on thyroid dysfunction will continue to be questioned and that answers will be pursued.

1. Endocrine Disruptors and the Thyroid Gland: Environmental Health Perspectives, Vol. 115(suppl 1):77-83
3. www.dtsc.ca.gov/hazardouswaste/perchlorate/

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