12. Regulating Perchlorate (ClO_4^-) in Drinking Water: Protecting Public Health

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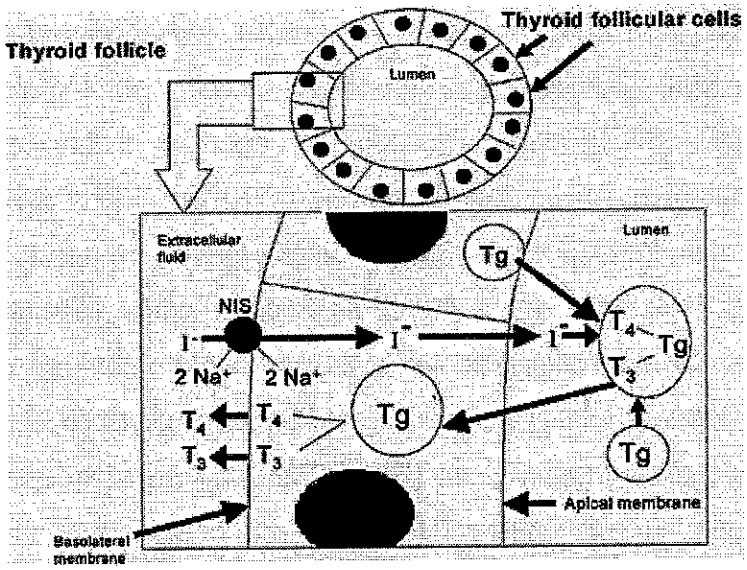
Perclorate (ClO_4^-) is an additive used in solid propellant for rockets, missiles, and explosives. In 1997 California found that perchlorate was a widespread contaminant of drinking water with more than 11 million people affected in the U.S. In September of 2004 substantial perchlorate contamination was found in several wells at Ramat Hasharon. Perchlorate can inhibit iodide uptake by the thyroid gland resulting in decreased production of thyroid hormones, needed for fetal and postnatal growth and development.



Schematic showing uptake of iodide into the thyroid and synthesis of thyroid hormones (NAS, 2005)

In 2002, the U.S. EPA recommended a drinking water maximum contaminant level (MCL) of 1 ppb. This highly controversial regulation prompted several agencies to request that National Academy of Sciences (NAS) to review the EPA draft. The NAS (2005) review criticized the lack of credence given by the EPA to a human exposure study (Greer et al., 2002), showing that 7 μg/kg-

day did not inhibit iodine uptake in healthy adults. A 10-fold safety factor applied to this value gives an RfD of 0.7 μg/kg-day, which resulted in a DWEL (MCL assuming 100% of exposure is from drinking water) of 24.5 ppb.

Pregnant woman with iodine deficiency, prenatal and neonatal infants are regarded as the most sensitive populations, therefore exposure regulations must be particularly protective of them. Our knowledge base is large for perchlorate through many quality human epidemiological, clinical and occupational studies of perchlorate exposure, including of pregnant woman and their offspring. The U.S. EPA based their RfD and MCL recommendations exclusively on animal studies and inclusion of large uncertainty terms into their risk assessment calculations. However, several observations made from high quality human studies suggest that such uncertainty might not have been necessary. For example, the mechanism of action of perchlorate toxicity at both the molecular and physiological levels and, as well, the dose-response relationships at environmentally relevant concentrations are thoroughly understood. Although these understandings should serve to decrease much of the uncertaintly in perchlorate regulation, proposed RfDs and MCLs tend to be highly conservative, perhaps even that of the NAS (2005). The threshold for iodine uptake inhibition (IUI) in human clinical studies is about 200 ppb, which is a no observed adverse effect level. Human ecological and occupational studies show no adverse effects at levels up to 17,500 ppb drinking water equivalents. Comparative risk assessment indicates that IUI from typical U.S. diets corresponds to perchlorate drinking water concentrations of at least 1,500 to 29,000 ppb. The contribution of environmental perchlorate to total dietary IUI is negligible. all of which strongly indicate that perchlorate may be present in drinking water at substantially higher levels than have been proposed and still be protective of public health.

References

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