Thyrodine

PHYSIOLOGY OF IODINE

A compilation by: W. Robert Doenges **PRELIMINARY**

Background:
An excellent source of information regarding iodine historical use in medicine, present day assumptions, sufficiency, safety and physiological implications is available in papers written by Dr. Guy Abraham, Dr Jorge Flechas and Dr. David Brownstein for The Original Internist publication. These papers are available from the web at www.optimox.com. Or a search in Google for the iodine supplement Iodoral will yield the same results.

We encourage the reader to acquaint themselves with the aforementioned papers. A brief summary of their work is included as follows:

History summary:
Swiss physician J.F. Coindet in 1812 had success treating goiter (extreme hypothyroidism) with seaweed and reasoned elemental iodine was the primary reason for his patient's improvement. He tried tincture of iodine at 250 mg per day with great success in 150 goiter patients. Over the last century physicians refined the iodine compounds until French physician Gene Lugol's in 1829 devised his formula of 12.5 to 37.5 mg of iodine with potassium iodide in water as the most efficient and sufficient dose. Addition of potassium iodide increased the solubility of iodine sufficiently to be more clinically valuable.

Lugol's formula was used very successfully until the 1930s for the treatment of hypothyroidism, hyperthyroidism and other medical conditions that demonstrated efficacy. It is noteworthy that only 0.05 mg/day of iodine is necessary to prevent goiter. This amount is available in iodized salt thereby eliminating goiter as a prevalent health concern. However 0.05 mg/day is not enough for optimal health. Iodine is the one halogen (chlorine, bromine and fluorine are the others in order of increasing oxidizing potential) the body requires for many biochemical processes.

History of sufficiency:
In the 1930s physicians started using the recently developed thyroid hormones for treatment of thyroid hypo- or hyper- activity. The assumption was that iodized salt provided iodine sufficiency. Even though the chloride in table salt is a competing halide (chlorine - halogen) there is enough uptake of iodine in iodized salt from the potassium iodide to prevent goiter. Therefore synthetic (patentable) thyroid hormone replacement was developed to increase the thyroid's production of T4 (thyroxine).

Hintze et al (1) compared the response of patients with simple goiter to administration of I at 400 ug/day and to the administration of T4 at 150 ug/day…. Iodine was more effective by itself than the administration of the T4 hormone by itself.

Most people get iodine in their diet from seafood and iodized salt. However, only about 50% of Americans use iodized salt and because of concerns about high blood pressure, many people have reduced their salt intake. One gram of salt contains 77 mcg of iodine. Because of the high chloride content in table salt, some experts estimate that only about 10% of the iodine in iodized salt is actually absorbed. The recommended daily allowance (RDA) of iodine is 150 mcg (somewhat higher for pregnant women and certain other groups). Though 150 mcg daily may be sufficient to prevent an

enlarged thyroid (goiter) and cretinism (severe iodine deficiency in babies leading to mental retardation and impaired development), these values are far short of the optimal values of 12,500 mcg (12.5 mg) recommended by Dr. Abraham. But, even using the lower values, many people still do not get the RDA and tests have shown that the average blood levels of iodine have decreased significantly over the past 30 years, in part no doubt, due to the substitution of bromide for iodide in baked goods in the early 1980's.

A popular assumption is that physiologic doses of iodine are toxic. In the 1940s a study linked non-radioactive iodine to toxic reactions. It was plainly not true. T4 (thyroxine has 4 iodine atoms) and T3 (triiodothyronine has 3 iodine atoms) are the thyroid's hormones that are control metabolism. Both have iodine atoms in their molecules. It is obvious that iodine sufficiency is needed for optimal metabolism.

Is there a relationship between iodine and chronic fatigue and other disorders?
Dr. Brownstein writes: "The illnesses that iodine/iodide has helped are many. These conditions include Fibromyalgia, thyroid disorders, chronic fatigue immune deficiency syndrome, autoimmune disorders as well as cancer. Most patients who are deficient in iodine will respond positively to iodine supplementation. In fact, I have come to the conclusion that iodine deficiency sets up the immune system to malfunction which can lead to many of the above disorders developing. Every patient could benefit from a thorough evaluation of their iodine levels." (2)

Is there a probable relationship to fibrocystic breast disease (FDB)?
Mainland Japanese women have a very low incidence and prevalence of FDB and breast cancer. (13) Several investigators have proposed that the essential element I was the protective factor in mainland Japanese. (4 – 10) If indeed, the essential element I is the postulated protective factor, the administration of I to American women in amounts equivalent to that consumed by mainland Japanese women would be expected to protect them from breast cancer and improve FDB, as previously proposed by Stadel for breast cancer and confirmed for FDB by Ghent et al. (7) Based on data supplied by the Japanese Ministry of Health, the average daily I intake in mainland Japanese is 13.8 mg. (6)

The administration of thyroid hormones to I-deficient women may increase further their risk for breast cancer. In a group of women undergoing mammography for screening purposes (14) the incidence of breast cancer was twice as high in women receiving thyroid medications for hypothyroidism (most likely induced by I deficiency) than women not on thyroid supplement. The mean incidences were 6.2% in controls and 12.1% in women on thyroid hormones. The incidence of breast cancer was twice as high in women on thyroid hormones for more than 15 years (19.5%) compared to those on thyroid hormones for 5 years (10%).

Sodium – iodide symporter:

The ability of the thyroid gland to transport and concentrate iodide from blood is absolutely necessary for the synthesis of thyroid hormones. The key player in this process is the sodium-iodide symporter, an integral membrane protein that resides in the membrane of thyroid epithelial cells. As its name indicates, the sodium-iodide symporter simultaneously transports both Na^+ and I^- ions from extracellular fluid (i.e. blood) into the thryoid epithelial cell. Considering critical role of iodine trapping in thyroid function, it is not surprising that abnormalities in expression or function of the symporter can lead to thyroid disease.

The sodium-iodide symporter is most highly expressed in thyroid epithelial cells. Lower levels of expression can be detected in mammary gland, **salivary gland**, stomach and colon, but none of these tissues is known to organify iodide. The presence of the symporter in mammary gland leads to secretion of iodine in milk, which is probably important for thyroid function in neonatal animals. (18 – 22)

One atom of iodine is transported into the cells for every 2 atoms of sodium via the sodium/iodine symporter (NIS). There is also a chloride/iodide symporter called pendrin. Normal saliva/serum iodide ratio is approx. 42. Less than 20 may be due to toxins or very high levels of bromine/fluorine binding to the symporter.

Goitrogens including

- bromine (from fruit fumigants and processed bakery products)
- chlorine (chloramine byproduct from drinking water chlorination)
- ammonium perchlorate (rocket fuel found in tap water)
- fluorine (naturally occurring in well water plus drinking water fluoridation)
- thiocyanate (from cigarette smoke)

can bind to the NIS (receptor) and damage it preventing iodine from entering the cell. The receptor can possibly be repaired with vitamin C (3000 mg/day) and Celtic (unrefined) sea salt. (16)

The basil membrane of the thyroid cell has the specific ability to pump iodine into the interior of the thyroid cell. This is called *Iodide Trapping*. In a normal gland the iodine pump concentrates the iodide to about 30 times the concentration in blood. The rate of trapping is influenced by TSH in a negative feedback control method. (17)

Clinical experience:
For clinical experiences the following references are useful.

Fibrocystic Breasts by Jonathan V. Wright, M.D., Published in “Nutrition & Healing” – July 1995

David Brownstein, MD., Iodine. Why You Need It Why You Can’t Live Without It. 2nd Ed. 2006

Saliva iodine significance:
There is ample evidence of renal iodine clearance in the literature in Dr. Abraham’s references and some evidence of salivary uptake from other sources. According to Mr. Zareba under a NASA grant, the mean correlation coefficient (*r*) between iodine elimination for blood/saliva was 0.99, for blood/urine, 0.95, and for saliva/urine, 0.97. The absolute value of iodine concentrations in urine revealed marked variability, which was corrected by adjusting for creatinine levels. (15) That is, with normal symporter there is excellent correlation between the iodine concentration increase in serum and saliva. However, the timing is different.

From Bruger and Member, thyroxine was not concentrated from the blood to saliva but elemental potassium iodide (KI) was from 5 to 7 times that of the blood. The maximal amount of iodine concentrated in the saliva occurred 1 to 2 ½ hours after ingestion of KI peaking to 1200 times the initial salivary iodide. The salivary/blood iodine ratio in the control period was 6 and reached a maximum of 28, 8 hours after ingestion of the iodide. (18) Obviously measuring salivary iodide within several hours of supplementation will result in a very high unusable reading. This effect has been verified by our own tests. Note that normal iodide trapping in the thyroid is about 30 times that in the blood.

Implications:

The hypothesis is that since the salivary iodide uptake from the interstitium and thyroid trapping iodide from the blood is approximately the same order over time, the saliva uptake can be a rough indication

of thyroid uptake. If this is true then the saliva/urine ratio can be a rough indication of thyroid iodide sufficiency. There is some anecdotal evidence from non-traditional research to suggest this relationship. Examples are as follows:

J was supplementing Iodoral® (7.5 mg KI + 5 mg Iodine per tab) at the rate of 50 mg/day for nine months (without adverse effect) encouraged by the idea of clearing mercury toxicity (a dental assistant) and tested at 25 PPM saliva and 60 PPM urine iodide. One would expect that after nine months supplementation at this dosage, iodine sufficiency would have been reached. The saliva/urine ratio of < 1 suggests this conclusion.

Dr. T supplementing for many years with an organic bound iodine in seaweed extract tested 17 PPM saliva and 15 PPM urine. The supplementation will continue but one would expect sufficiency with this long term supplementation. Again the ratio approached 1.

B supplementing 6 months 12.5 mg/day Iodoral® tested 9 PPM saliva and 6 PPM urine suggesting a higher dosage could be used to approach higher residual levels and a lower ratio suggesting sufficiency as not reached. The 24 urine iodine loading test would be appropriate.

M was not supplementing but ate substantial amounts of seafood and mostly Mexican foods but very little US produced processed foods. M's saliva tested 17 PPM and urine 15 PPM.

20 other subjects were tested who were not supplementing except for iodized salt and multivitamin tabs with iodine in the 100 ug range. None were consuming substantial ocean dwelling foods. Usual tests were 1 PPM saliva and 0.1 PPM urine. The absolute values are very low and the ratio is 10. Again a 24 hour urine loading tests would probably support this conclusion.

Testing was performed in the morning with no fast required. It is recommended that a 12 hour fast, 8:00 PM to 8:00 AM for example, be required in order to minimize the effects of hydration.

Future studies

The QFA 1500 analyzer does not purport to provide sensitivities less than 0.1 mg/L (PPM) but is sensitive enough to measure the uptake effects of iodine supplementation whether in Lugol's formula (as Iodoral® of 7.5 mg potassium iodide and 5 mg elemental iodine) or other organic form such as kelp, dulse or seaweed extract.

The hypothesis of measuring the ratios of saliva vs urine iodine as a measure of sufficiency and blood vs. urine as an indicator of availability of iodine for the tissues (iodine symporter) is unproven except from anecdotal information. Nevertheless a good body of information will be obtained through this simple test coupled with other observation to arrive at conclusions outside traditional expensive and sometimes inaccurate or incomplete medical studies.

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