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ATTENTION

Public Health

Update

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This information is provided to physicians by the Westchester County Department of Health for general education purposes, and may be updated in the future.

Potassium Iodide (KI)

Why the new interest in KI?

On January 19, 2001, the NRC amended its emergency planning regulations to require States or Tribes with populations within the 10-mile emergency planning zone of commercial nuclear power plants to consider including potassium iodide (KI) as a protective measure for the general public to supplement evacuation and sheltering in the unlikely event of a nuclear power plant accident. (Previously KI was recommended for consideration for sheltered populations and emergency workers.)

In December 2001, the FDA issued new guidance that, based on research done after the Chernobyl incident, KI does have a positive effect in reducing thyroid cancer following a radioactive iodine release, and issued new recommendations for specific dosages of KI to be taken by seven different segments of the population.

Iodine prophylaxis is one aspect of a variety of protective actions that are considered after a serious accident at a nuclear power facility involving the release of radioactive agents. However evacuation remains the protective action of choice. Evacuation not only protects the public from exposure to the radioiodines, but also provides protection from all other radionuclides that could possibly be released during a nuclear emergency.

Thyroid protection using Potassium Iodide

The thyroid gland requires the element iodine for hormone production. The normal American diet amply supplies this nutrient. Some of the materials that can escape to the atmosphere during a reactor accident are radioactive forms of iodine. A fraction of the

radioiodines taken in the body accumulates in the thyroid and proceeds to irradiate the gland.

If the thyroid is saturated with stable (non-radioactive) iodine in the form of potassium iodide (KI) before radioiodines are taken into the body, the radioiodines fail to deposit in the gland, and 90% of the radiation dose from the radioiodines is avoided, i.e. the gland is said to be “blocked”. To achieve the maximum blocking effect, however, the gland must be saturated with KI before the inhalation or ingestion of the radioiodine occurs. The delay of just a few hours reduces the effectiveness to 50% or less.

Among the reasons for the seriousness of the iodine hazard are its unique biologic effects. A large fraction of the inhaled iodine is in soluble form and is quickly absorbed into the bloodstream. Inhaled iodine becomes in equilibrium with body fluids in about 30 minutes. Five to 35% of the ingested iodine collects in the thyroid and is released with a relatively long (138-day) biological half-life. The remainder of the iodine entering the body is excreted fairly rapidly and is essentially gone in 48 hours.

Experiments with adult human volunteers indicate that 100 mg of stable iodine taken one-half hour to approximately one day before exposure to radioiodine produces thyroid blocking. The smallest amount of stable iodine required to produce blocking of the thyroid is about 30 mg. The time taken to achieve the blocked state decreases from about two hours after the oral administration of 30 mg of iodine to 30 minutes after 100 mg. Amounts of iodine larger than 100 mg. do not appear to reduce the time any further. The 100 mg of iodine can be obtained by taking one tablet of potassium iodide (130 mg).

How often should KI be administered?

The protective effect of KI lasts approximately 24 hours. For optimal prophylaxis, KI should therefore be dosed daily, until a risk of significant exposure to radioiodines by either inhalation or ingestion no longer exists (except for pregnant women – see precautions). FDA indicates that across populations at risk for radioiodine exposure, the overall benefits of KI far exceed the risks of overdosing, especially in children, though it continues to emphasize particular attention to dose in infants.

The need for blocking agents is estimated as being required for 3 to 7 days and probably no longer than 10 days for a total dose of about 1 gram.

What are the risks to the thyroid from radioiodine?

The radiation dose to the thyroid that results from the uptake of radioactive iodine increases the risk of thyroid cancer, especially among children. Observations in Europe following the Chernobyl reactor accident in 1986 suggest that the younger the child at the time of exposure the greater the risk of thyroid cancer, and that, especially in young children, it may accrue at very low levels of radioiodine. Also high radiation doses to the thyroid can induce hypothyroidism, both in children and adults.

How effective is the use of potassium iodide?

Potassium iodide (KI) when taken before, or shortly after exposure to radioiodine is effective in reducing its uptake by the thyroid gland, which reduces the risk of thyroid cancer in individuals or populations at risk for inhalation or ingestion of radioiodine. KI does not protect against radiation doses received from external sources of radiation or from radionuclides, other than radioactive isotopes of iodine that may be ingested or inhaled in an emergency. It also does not protect body organs or tissues, other than the thyroid. FDA has determined that short-term administration of KI at thyroid blocking doses is safe and, in general, more so in children than adults.

What are the side effects of KI?

The risks of stable iodine administration include sialadenitis (inflammation of the salivary gland), gastrointestinal disturbances, allergic reactions and minor rashes. In addition, persons with known iodine sensitivity should avoid KI, as should individuals with dermatitis herpetiformis and hypocomplementemic vasculitis, extremely rare conditions associated with an increased risk of iodine hypersensitivity.

Thyroidal side effects of stable iodine include iodine-induced thyrotoxicosis, which is more common in older people and in iodine deficient areas but usually requires repeated doses of stable iodine. In addition, iodide goiter and hypothyroidism are potential side effects more common in iodine sufficient areas, but they require chronic high doses of stable iodine. Therefore, individuals with multinodular goiter, Graves' disease, and autoimmune thyroiditis, most likely to be adults, should be treated with caution, especially if dosing extends beyond a few days.

Transient hypothyroidism was observed in 0.37% (12 of 3214) of neonates treated with KI in Poland after the Chernobyl reactor accident in 1986, with no reported sequelae to date.

What precautions are recommended if KI is used?

Pregnant women should be given KI for their own protection and for that of the fetus, as iodine (whether stable or radioactive) readily crosses the placenta. However, because of the risk of blocking fetal thyroid function with excess stable iodine, repeat dosing with KI of pregnant women should be avoided. Lactating females should be administered KI for their own protection, as for other young adults, and potentially to reduce the radioiodine content of the breast milk, but not as a means to deliver KI to infants, who should get their KI directly. As for direct administration of KI, stable iodine as a component of breast milk may also pose a risk of hypothyroidism in nursing neonates. Therefore, repeat dosing with KI should be avoided in the lactating mother, except during continuing severe contamination. If repeat dosing of the mother is necessary, the nursing neonate should be monitored.

FDA determined that the benefits of KI treatment to reduce the risk of thyroid cancer outweigh the risks of such treatment in neonates. However, in light of the potential consequences of transient hypothyroidism for intellectual development, FDA recommends that neonates treated with KI be monitored for this effect by measurement of TSH (and FT4, if indicated).

Thyroid hormone therapy should be instituted in cases in which hypothyroidism develops. Drug interactions also should be considered, particularly in the adult population.

What are the recommended prophylactic doses of KI?

FDA recommendation for administration of KI based on age, predicted thyroid exposure, and pregnancy and lactation status are given in the table below:

Threshold Thyroid Radioactive Exposures and Recommended Doses of KI for Different Risk Groups				
	Predicted Thyroid exposure(cGy)	KI dose (mg)	# of 130 mg tablets	# of 65 mg tablets
Adults over 40 years	≥500	130	1	2
Adults over 18 through 40 years	≥10			
Pregnant or lactating women	≥ 5			
Adolescents over 12 through 18 years*	≥ 5	65	1/2	1
Children over 3 through 12 years		32	1/4	1/2
Over 1 month through 3 years				
Birth through 1 month				

*Adolescents approaching adult size (≥ 70 kg) should receive the full adult dose (130 mg).

How will one know if the use of KI is indicated in an emergency?

The use of KI is only indicated in emergencies where the public is likely to be exposed to radioactive iodine. The State and County Health Departments monitor all radiation emergencies and will issue advisories informing the public if KI will help in reducing the radiation dose to the thyroid. In those cases where KI is indicated, the Health Departments will also issue advisories on when the administration of KI is no longer needed.

Does KI come in solution form or tablet form?

It can be in either form. For prophylactic use in nuclear power plant emergencies in the US it is marketed in a tablet form. After the 1986 Chernobyl accident, Poland used the liquid form to administer KI to its population.

Can KI be purchased at local pharmacies?

Although FDA has approved some forms of KI as non-prescription medication for prophylaxis, KI manufacturers are not currently providing it to pharmacies in New York State in significant quantities. It can currently be purchased over the Internet.

As a result of the NRC and FDA guidance, New York State Emergency Management Office and Westchester County Department of Emergency Services are reviewing availability of KI to the general population.

Sources of Information:

www.fda./cder/guidance/4825fnl.htm

www.who.int./environmental information/Information resources/documents/Iodine/guide.pdf

www.health.state.ny.us/nysdoh/consumer/environ/homeenvi.htm

Center for Drug Evaluation and Research, "Guidance: Potassium Iodide as a Thyroid Blocking Agent in Radiation Emergencies," USDHHS, FDA, December 2001 Procedural.