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IODIDE AND PERCHLORATE BLOCK UPTAKE OF RADIOIODINE TO PREVENT THYROID CANCER, BUT YOUNGER PEOPLE REQUIRE HIGHER DOSES

Hänscheid H, Reiners C, Goulko G, Luster M, Schneider-Ludorff M, Buck AK, Lassmann M. **Facing the nuclear threat: thyroid blocking revisited.** J Clin Endocrinol Metab. August 24, 2011 [Epub ahead of print].

BACKGROUND

Radioiodine-131 is a major fission product released into the atmosphere after a nuclear accident and results in contamination of water and soil. It may be ingested through food and water that is contaminated with 131-iodide. Radioidine-131 from the Chernobyl accident resulted in a dramatic increase of thyroid cancer in children who were exposed to the radiation. To prevent thyroid cancer from thyroid uptake of 131-iodide, the World Health Organization and the U.S. National Research Council have recommended that the potentially exposed population be given tablets containing 100 mg of iodide as potassium iodide to block the uptake of the radioidide.

The purpose of the present study was to evaluate sodium perchlorate (SP) as a blocking agent, as compared with potassium iodide (KI), and to evaluate the prediction of the effectiveness of this therapy.

METHODS

Twenty-seven healthy euthyroid subjects with a mean age of 25 years participated in 48 studies of ¹²³I kinetics in the thyroid. Patients first had a study of iodine uptake with 0.14 mCi ¹²³I (13.3 hr physical half-life) with uptake measurements at 2, 6, 24, and 48 hours. This was followed by a study of the blocking agent with a dose of 0.7 mCi ¹²³I. The different interventions were tested in subgroups of six or seven volunteers: 100 mg of KI 24 hours before or 2, 8, or 24 hours after ¹²³I exposure; 100 mg of SP 2 hours after exposure; or 1 g of SP 2 or 8 hours after exposure.

RESULTS

The highest mean reduction of thyroid absorbed dose, 88.7%, was found in individuals blocked with 100 mg of KI at 24 hours before exposure. The mean reduction in subjects blocked at 2, 8, and 24 hours after the injection of ¹²³I was reduced to 59.7%, 25.4%, and 2.8%, respectively (P <0.001). The *continued on next page*

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reduction by 100-mg and 1000-mg perchlorate at 2 hours was 56.9% and 58.3%, respectively, and the reduction by 1000-mg perchlorate at 8 hours was 7.4%. The effects of perchlorate were not significantly different from the 100-mg dose of KI at similar times.

The time for blockade of further uptake, after the blocking agent was given orally was calculated to be about 15 minutes. Additional thyroid uptake after the intervention did not exceed 2% of the dose. It appeared that the 100-mg dose of perchlorate was slightly less effective at blocking further uptake, but this was probably not significantly different from the other blocking regimens.

Iodine kinetics were significantly faster in subjects younger than 25 years of age, as compared with those older than 25. The time of intervention to achieve a 50% dose reduction was 2.4 hours for the subject with the fastest kinetics and 9.2 hours for the subject with the slowest kinetics.

CONCLUSIONS

Current guidelines for blocking ¹³¹I uptake are adequate for older individuals but probably overestimate the efficacy of blocking in young individuals, who have faster kinetics. Perchlorate may be used for thyroid blocking as an alternative for individuals with iodine hypersensitivity or those at risk for thyrotoxicosis.

COMMENTARY • • • • • • • • • • • • • • • • •

At a time of a nuclear disaster, shielding from radiation by distance, staying indoors, and taking all other measures to avoid exposure to radiation are important. Public authorities must act quickly to distribute iodide tablets to the population who may be exposed in order to prevent thyroid uptake of ¹³¹I that has strong beta radiation, which can induce DNA damage and result in thyroid cancer. The data of this paper show that the best blockade occurs when the blocking agent is given before the isotope is administered. The conclusion that thyroid iodine kinetics vary among individuals is not novel, but the point that younger people have faster turnover and may need a larger blocking dose given at an earlier time is important.

In 2002, the American Thyroid Association took the position that KI should be available and distributed to families living within 50 miles of a nuclear plant. In 2004, the National Research Council published Distribution and Administration of Potassium Iodide in the Event of a Nuclear Incident (1). In a quick review of this book, I could not find the amount of iodine in the tablet. A commercial tablet called Iostat contains 130 mg of KI, equivalent to 100 mg of iodide; we may

assume that KI tablets contain 100 mg of iodide when the amount is not specified. Surprisingly, the article reviewed here used 100 mg of KI, which would be equivalent to only 77 mg of iodide. It is also surprising that the authors did not refer to the landmark paper of Braverman and colleagues (2), which showed that 130 mg of KI reduced 24-hour uptake of ¹²³I to <1%, data similar to those of the present study. Based largely on Braverman's work, the Food and Drug Administration (FDA) in 2001 recommended that people potentially exposed to radioiodine fallout take potassium iodide tablets that contain 100 mg of iodide per day to block thyroid uptake of the ¹³¹I for prevention of thyroid cancer (http://www.fda.gov/downloads/ Drugs/GuidanceComplianceRegulatoryInformation/ Guidances/ucm080542.pdf). However, the FDA recommended half this dose for people younger than 18 years of age, a dose that may be too low based on the present paper.

Monte Greer and colleagues showed that a dose of 0.5 mg of perchlorate per kilogram per day reduced thyroid uptake of 123 I by 67% (3). A cell model developed to test the blocking effect of 131 I-induced DNA double-strand breaks by monovalent anions that compete for iodide transport showed that *continued on next page*

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perchlorate was sixfold more potent than iodide (4). It is unfortunate that doses of perchlorate lower than 1000 mg were not tested by Hänscheid and colleagues before administration of the radioiodine in order to determine what dose of perchlorate would be as effective as 100 mg of KI when given beforehand. The in vitro cell model also showed that incubation with blocking anions less than 1 hour after incubation of the cells with ¹³¹I was much less effective in preventing the DNA damage that is a precursor to cancer (4).

— Jerome M. Hershman, MD

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