Bulletin #50

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Radioiodine Treatment for Thyroid Disease

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Introduction

Radioiodine is a radioactive isotope of Iodine. It is an antithyroid radiopharmaceutical agent used to treat patients with some of the most common types of thyroid diseases, most importantly Graves' disease and thyroid cancer. The uptake of the radioactive iodine by thyroid tissue can also be visualized with gamma scanners and therefore we also use radioiodine for thyroid gland imaging.

How does it work?

Normal thyroid tissue takes up iodine from blood. Like iodine, RAI (radioactive iodine) or radioiodine is similarly taken up by thyroid cells. It is taken orally, and can be administered as a capsule or solution. The iodine is subsequently concentrated in thyroid tissue. RAI then emits beta radiation which causes thyroid cell death. It induces tissue damage, resulting in ablation of the thyroid tissue within 5 to 20 weeks. This therapy can therefore be used to treat and typically cure hyperthyroidism due to Graves' disease and certain other causes, as well as certain types of thyroid cancer.

RAI is also used for thyroid gland imaging. Scanners can detect the radiation that is emitted by the radioactive isotope. A different isotope than the one used for therapy is preferred for imaging. Doses used in thyroid gland uptake and scanning are much lower and the isotope is harmless to the gland. Doses used for treatment of hyperthyroidism are higher, but the largest doses are used in the treatment of thyroid cancer, and more so in metastatic (spreading) disease. Side effects related to the radioactive iodine therapy are more commonly seen following treatment of thyroid cancer since there is a need for higher doses.

Most patients are rendered hypothyroid within a few weeks following a single dose of RAI used for ablation in Graves' hyperthyroidism. Some patients may retain normal thyroid function or remain mildly hyperthyroid but this is more commonly seen with smaller than the standard doses of RAI used for ablative therapy. A minority of patients especially those with severe hyperthyroidism or larger goiters may fail to respond completely following a single dose of radioiodine treatment and then require a second dose.

Indications and Use

RAI is a well-established and well tolerated therapy for hyperthyroidism. It can be used to treat hyperthyroidism from Graves' disease, toxic or hyper-functioning nodules or toxic goiter. It is the therapy of choice for Graves' hyperthyroidism, preferred over the other

conventional therapies (thionamide agents and surgery) by 60 percent of thyroidologists in a recent survey in 2011.

RAI is administered after thyroidectomy in patients with thyroid cancer to destroy any residual disease. Not all patients with thyroid cancer require RAI therapy and several different criteria based on tumor characteristics are used to determine the need and doses of the RAI.

Thyroid uptake and scans done during diagnosis and monitoring of thyroid cancer and in management of hyperthyroidism for example in Graves' disease utilize RAI, but in much smaller doses than those used in the treatment of thyroid cancer or hyperthyroidism.

Pregnancy and breastfeeding are absolute contraindications to RAI, and women who are treated with RAI are advised to wait at least 12 months before becoming pregnant. Patients must avoid close contact with young children for several days after RAI administration.

Some studies suggest a low iodine diet with dietary iodine restriction for several weeks prior to RAI administration results in increased efficacy of RAI and better clinical outcomes than in patients not receiving a low iodine diet.

Following treatment with RAI, free thyroxine levels should be measured within the first 6-8 weeks and then at 4-8 week intervals to determine when to initiate thyroid hormone replacement therapy and to identify the proper maintenance dose. Once thyroid hormone levels have been stabilized, periodic testing at 6 to 12 month intervals is performed.

Complications

RAI therapy in Graves' disease may be associated with an increased risk of development or a worsening of Graves' ophthalmopathy, particularly in smokers and patients with high baseline serum concentration of triiodothyronine (T3) hormone levels or high antibody titers. Anti-thyroid drugs or surgery are preferred treatment options for patients with moderate-to-severe or sight threatening eye involvement. However some experts may not consider moderate to severe ophthalmopathy an absolute contraindication to radioiodine, since the risk could technically be ameliorated with prophylactic steroids.

Complications commonly seen following larger doses of RAI used in thyroid cancer include nausea, radiation induced thyroid gland inflammation, radiation induced inflammation of salivary glands, painless neck swelling, and tumor hemorrhage.

Effects on gonadal function resulting in transient low sperm concentration, decreased ovarian function, and amenorrhea can occur following higher doses of RAI used in thyroid cancer. There is a reported small increased risk of secondary malignancies, in particular salivary gland malignancies and leukemia following RAI ablation of thyroid cancer.

Following RAI treatment of Graves' disease, antibody levels can increase or remain persistently elevated. In pregnant women with a history of Graves', antibodies to the thyrotropin (TSH) receptor should be measured, since these antibodies can cross the placenta. Fetal and neonatal surveillance for thyroid dysfunction should be initiated if antibody levels are high.

Radiation Safety

Patients receiving a standard dose of RAI for a thyroid uptake and scan, hyperthyroidism, and even thyroid cancer can typically be discharged home immediately following its administration as long as they follow specific restrictions given to avoid any increased risk of radiation exposure to the general public. With larger doses, inpatient admission maybe required. Patient

release criteria are thus variable. Specific instructions with regard to duration of restriction and post-treatment precautions are provided to patients based on patient specific characteristics and RAI dose, and are explained prior to therapy by the administering physician.

In general patients should avoid close contact with the general public and remain at least six feet away from family members for the first 24 hours after RAI administration. With higher doses generally used in thyroid cancer, especially in metastatic disease, patients may need to avoid close contact with family members for a longer period, especially around pregnant women and children. The patient should avoid sharing a bed with another person, any close physical contact, sharing utensils, towels and other personal care items following the therapy. The RAI dose, amount of thyroid tissue ablated, and calculated rate of clearance of RAI determine the duration of the restriction for the individual patient.

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