



Childhood Head & Neck Irradiation

WHAT IS THE THYROID GLAND?

The thyroid gland is a butterfly-shaped endocrine gland that is normally located in the lower front of the neck. The thyroid's job is to make thyroid hormones, which are secreted into the blood and then carried to every tissue in the body. Thyroid hormone helps the body use energy, stay warm and keep the brain, heart, muscles, and other organs working as they should.

EXPOSURE CONCERN AND DETECTION

The thyroid gland can be affected by exposure to radiation. Radiation can come from an external source, such as radiation given for childhood cancer, or it may come from an internal source, such as the ingestion of a radioactive iodine compound. The thyroid glands of children are more sensitive to radiation compared with adults, and the effects of radiation may not be seen until years or sometimes decades after the exposure. Therefore, in order to detect and treat thyroid disease if it occurs, life-long follow-up is recommended in children with radiation exposure to the thyroid gland.

WHAT IS THE CONCERN ABOUT THE THYROID GLAND AND RADIATION?

Radiation exposure can cause several different thyroid problems, including an underactive thyroid (hypothyroidism), overactive thyroid (hyperthyroidism), benign thyroid nodules (lumps), and thyroid cancer (most often papillary thyroid carcinoma). The risk of developing radiation-induced thyroid disease depends on numerous factors, including the age of the child at the time of treatment, the radiation dose delivered to the thyroid, and the time elapsed since radiation exposure.

HOW CAN A CHILD BE EXPOSED TO RADIATION?

Radiation exposure most often occurs in the setting of medical treatment for cancer. It is an important part of the treatment of several types of childhood cancers, including lymphoma, leukemia, brain tumors, sarcomas, neuroblastoma, and nasopharyngeal carcinoma. Radiation is also sometimes used to prepare patients for stem cell transplant. In addition to external radiation given to treat

the cancers listed above, internal radiation (specifically a compound named ^{131}I -MIBG) is sometimes used to treat metastatic neuroblastoma, and this has been associated with the development of hypothyroidism and thyroid tumors. Radioactive iodine is also used to treat a condition called *Graves' Disease*. However, the doses associated with this treatment are not thought to contribute significantly to the risk of developing thyroid cancer.

Rarely, radiation exposure also can be accidental. This has occurred during nuclear accidents or nuclear bomb tests (see *Nuclear Radiation and the Thyroid brochure*). In the past, radiation therapy was also used to treat some benign conditions, but is no longer used in this way.

WHAT ARE THE TYPES OF THYROID PROBLEMS THAT CAN OCCUR?

HYPOTHYROIDISM (see *Hypothyroidism brochure*).

- An underactive thyroid is the most common disease seen after radiation exposure. Depending on the dose of radiation, this can be mild (also called "compensated" hypothyroidism) or it can be more severe ("overt" hypothyroidism). This condition is effectively and easily treated with thyroid hormone taken as a pill (levothyroxine).

HYPERTHYROIDISM (see *Hyperthyroidism brochure*).

- An overactive thyroid can develop during treatment that exposes the thyroid to high doses of radiation; this is a temporary problem that is usually not treated, but it can lead to the development of hypothyroidism. Additionally, hyperthyroidism can also rarely develop years after radiation therapy, especially in Hodgkin disease survivors, and the clinical picture is similar to *Graves' disease* (see *Hyperthyroidism brochure*).

THYROID NODULES (see *Thyroid Nodule brochure*)

- Thyroid nodules occur when there is a growth of thyroid cells into a lump within the thyroid gland. Thyroid nodules are usually noticed several years after radiation treatment. They can be detected by a provider when he/she performs a physical examination of the neck and thyroid gland, or they can be seen using an ultrasound examination (picture of the thyroid gland obtained using sound waves).



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THYROID CANCER (see *Thyroid Cancer brochure*)

- Thyroid cancer, specifically a type called papillary thyroid carcinoma, may also occur after thyroid radiation exposure, especially with lower doses of radiation. The diagnosis may not be made until years or decades after the exposure. Radiation-induced thyroid cancers do not appear to be more aggressive in terms of long-term outcomes compared with disease diagnosed in patients without a history of radiation. Although papillary carcinoma after radiation may be more likely to be associated with neck lymph node disease, the risk of spread of the cancer outside of the neck is not clearly elevated. Death from thyroid cancer is extremely infrequent in childhood cancer survivors.

CAN ADULTS BE AFFECTED BY RADIATION EXPOSURE?

While the adult thyroid gland is much less sensitive to radiation, it too may be affected, especially during radiation therapy for head and neck cancers. Hypothyroidism, thyroid nodules and thyroid cancer all can occur after radiation exposure in adults.

HOW CAN THYROID PROBLEMS FROM RADIATION BE DETECTED?

Patients may or may not have symptoms of a thyroid problem. Therefore, the diagnosis of hypothyroidism and hyperthyroidism are made by monitoring the thyroid levels through a *blood test every year*. Thyroid nodules can either be detected by an ultrasound machine or when a provider examines the thyroid gland by touch. Once a patient has been found to have a thyroid nodule, the most likely next step is to perform a fine needle aspiration biopsy of the nodule (see *Thyroid Nodule and FNA brochure*), unless the nodule has completely benign characteristics on ultrasound. Fine needle aspiration helps to distinguish cancerous from non-cancerous nodules.

WHAT MEASURES CAN BE USED TO REDUCE THE RISK OF THYROID PROBLEMS AFTER RADIATION EXPOSURE?

In situations where radiation is thought to be important for diagnosing or treating medical conditions, steps are often used to reduce the risk of thyroid problems. For patients receiving external radiation for cancer treatment, doctors design the treatment to maximize effect to the tumor, while limiting the dose to nearby tissues such as the thyroid. Patients receiving ^{131}I -MIBG treatment receive a medication called Potassium Iodide or Lugol's Iodine to prevent the thyroid from taking up the radioactive drug. Finally, when X-rays are performed that are near the thyroid (such as dental X-rays), a lead collar can be used to protect the thyroid.

WHAT IS THE TREATMENT FOR THYROID PROBLEMS IN PATIENTS WHO HAVE RECEIVED RADIATION EXPOSURE AS CHILDREN?

In general, thyroid problems that occur as a result of radiation exposure are treated the same way as other patients who do not have been exposed to radiation therapy. The one difference is that treatment with thyroid hormone supplementation may be considered sooner in patients with mild hypothyroidism.

HOW LONG SHOULD A PHYSICIAN MONITOR SOMEONE WHO HAS HAD RADIATION TREATMENT?

Because thyroid problems can occur decades after radiation therapy is given, life-long monitoring is recommended. If a patient develops hypothyroidism after radiation treatment they will need life-long treatment with thyroid hormone.



FURTHER INFORMATION

Further details on this and other thyroid-related topics are available in the patient thyroid information section on the American Thyroid Association® website at www.thyroid.org.

For information on thyroid patient support organizations, please visit the *Patient Support Links* section on the ATA website at www.thyroid.org.

