Thyroid Dysfunction

HOW TO RECEIVE CREDIT

- Read the enclosed course.
- Complete the questions at the end of the course.
- Return your completed Evaluation to CME Resource by mail or fax, or complete online at www.NetCE.com. (If you are a Florida nurse or a behavioral health professional, please return the included Answer Sheet.) Your postmark or facsimile date will be used as your completion date.
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Faculty Disclosure
Contributing faculty, Marilyn Fuller Delong, MA, BSN, RN, has disclosed no relevant financial relationship with any product manufacturer or service provider mentioned.

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Division Planner Disclosure
The division planner has disclosed no relevant financial relationship with any product manufacturer or service provider mentioned.

Audience
This course is designed for nurses and other healthcare workers in all practice settings.

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Course Objective

As a result of the high prevalence of thyroid conditions, nurses and other healthcare providers encounter thyroid dysfunctional patients every day. The purpose of this course is to provide the most current information regarding thyroid disease diagnosis, treatment, and management to facilitate early diagnosis and treatment and optimum patient outcomes.

Learning Objectives

Upon completion of this course, you should be able to:

1. Discuss the incidence of thyroid disease both in the United States and around the world.
2. Describe thyroid anatomy and physiology.
3. Outline the pathophysiology of hypothyroidism, including possible causes and associated conditions.
4. Identify signs and symptoms of hyperthyroidism and effective treatment options.
5. Distinguish between various types of thyroid nodules and multinodular goiters.
6. Discuss thyroid cancer, including staging and treatment.
7. Describe special considerations when diagnosing and treating thyroid dysfunction in older patients.
8. Discuss the management of the patient with thyroid disease.

EVIDENCE-BASED PRACTICE RECOMMENDATION

Sections marked with this symbol include evidence-based practice recommendations. The level of evidence and/or strength of recommendation, as provided by the evidence-based source, are also included so you may determine the validity or relevance of the information. These sections may be used in conjunction with the course material for better application to your daily practice.

INTRODUCTION

One in every six Americans, or more than 30 million people in the United States, have some type of thyroid dysfunction, more than the number of Americans with diabetes and cancer combined [12; 29]. Internationally, the incidence is even greater. The majority of Americans with thyroid dysfunction, about 9.6 million, have hypothyroidism. A smaller number, approximately 2.6 million, have hyperthyroidism. Nearly half of all individuals with thyroid dysfunction are undiagnosed [31]. These statistics indicate that nurses and other healthcare workers are likely to encounter thyroid dysfunctional patients every day [2]. These problems are not only common and treatable; they are often lifelong conditions. It is important for healthcare providers to be aware of these conditions, how they are treated, and potential complications.

The endocrine system is composed of multiple glands that control every body system, and the thyroid gland is part of that system. When one part of the system malfunctions, it has a cascade effect to all the other glands. If the thyroid is excreting an excess of hormones or has a deficit of hormones, the ramifications can be felt in every portion of the body.

ANATOMY & PHYSIOLOGY

The thyroid gland is located in the anterior portion of the neck, inferior to the larynx. It consists of two lobes joined by an isthmus and is often described as being shaped like the letter "H" or a butterfly. Imbedded behind the four corners, or points, of the H shape are the parathyroid glands; in rare cases, parathyroid glands may be found in the subglandular fat or the chest. These glands are visually indistinguishable from the surrounding thyroid tissue except by microscopic examination and are often inadvertently affected by treatments to the thyroid.

The thyroid gland operates as part of a feedback mechanism involving the hypothalamus and the pituitary gland. Using iodine originating in the diet and blood, the gland makes thyroid hormones that are critical to several bodily functions. First, the hypothalamus sends a signal to the pituitary gland through thyrotropin-releasing hormone (TRH). When the pituitary gland receives this signal, it releases thyroid-stimulating hormone (TSH) to the thyroid gland. Upon receiving TSH, the thyroid responds by releasing two hormones, thyroxine (T_4) and triiodothyronine (T_3), which then enter the bloodstream and affect the metabolism of the heart, liver, muscles, and other organs. Finally, the pituitary gland monitors the level of thyroid hormone in the blood and increases or decreases the amount of TSH released, which then regulates the amount of thyroid hormone in the blood. This cycle constantly measures and re-deploys hormones in response to the amounts measured.

Persons with a normally functioning thyroid gland are described as being in a state of euthyroidism. As noted, the two main categories of thyroid dysfunction are hypothyroidism, or decreased secretion of thyroid hormones, and hyperthyroidism, the overproduction of these hormones. Most dysfunctional situations involving the thyroid gland are included in these two categories.

Diagnosis of suspected thyroid problems can be determined by laboratory testing to measure the amount of TSH, T_3, or T_4. Overt hypothyroidism is evidenced by an increase in TSH levels and a decrease in T_3 and T_4 levels. (Actual numbers vary from laboratory to laboratory.) However, subclinical hypothyroidism may show an increased but normal level of TSH with normal levels of free T_4. Low-normal or decreased TSH with increased levels of T_3 and T_4 is indicative of hyperthyroidism.

Subclinical hypothyroidism or hyperthyroidism may be overlooked due to the lack of symptomatology, but it is appropriate to do testing because evidence shows that even mild changes can be significant [8; 10]. In cases of subclinical hypothyroidism, myocardial performance is adversely influenced; both systolic and diastolic function may be affected. Similarly, subclinical hyperthyroidism may lead to increased risk of developing atrial fibrillation, tachycardia, congestive heart failure, thromboembolism, and stroke [36].

EVIDENCE-BASED PRACTICE RECOMMENDATION

The U.S. Preventive Services Task Force concludes the evidence is insufficient to recommend for or against routine screening for thyroid disease in adults. (http://www.guideline.gov/summary/summary.aspx?doc_id=4310. Last accessed September 11, 2009.)

Strength of Recommendation: I (The USPSTF concludes that the evidence is insufficient to recommend for or against routinely screening. Evidence that the service is effective is lacking, of poor quality, or conflicting and the balance of benefits and harms cannot be determined.)

HYPOTHYROIDISM

Hypothyroidism is not a disease itself, but rather a clinical manifestation of the underproduction of thyroid hormones. There are many potential causes for this underactivity, including congenital absence of the thyroid gland, surgical removal of the gland, pharmaceutical overtreatment of hyperthyroidism, lack of iodine in the diet, environmental issues, radiation therapy to the head or neck, and autoimmune disorders such as Hashimoto's thyroiditis [33].

As mentioned, thyroid disease affects more than 30 million Americans and is frequently undiagnosed. Overall, in the United States the prevalence of hypothyroidism in women is 7.5% (approximately 22 million); in men, the prevalence is about 2.8% (approximately 8.5 million). Worldwide, hypothyroidism is considered epidemic. It is estimated that 38% of the world's population is affected by hypothyroidism, and congenital hypothyroidism is a primary cause of mental deficiency [9].

Within the United States and other industrialized nations, iodine is consumed in adequate doses from the food supply, so iodine deficiency is not a major problem. In the past, residents of landlocked areas of the United States, where the availability of iodine-rich seafood was very limited, often had iodine deficiency-related goiters. The simple addition of iodine to table salt, creating iodized salt, has prevented much of this problem. In a lifetime, only one teaspoon of iodine is required to maintain appropriate thyroid gland functioning. However, the body does not store iodine well, so it must be given in very small amounts on a daily basis.

In developing countries, it is much harder for individuals to consume the necessary amount of iodine as many people simply do not have access to dietary sources. In some parts of the world, iodine deficiency remains a very serious problem [7; 24]. Iodine deficiency-related hypothyroidism is not limited to adults. Iodine deficiency during the prenatal period can lead to serious fetal effects, including brain damage, mental retardation, and dwarfism. Throughout the world, more than 100,000 children are born with mental retardation each year and another 50 million children have a congenital defect [7; 24].

In North America (both in the United States and Canada), newborns are screened at birth for the presence of congenital hypothyroidism with a simple blood test [12]. One out of every 4,000 to 5,000 infants in the United States is born with this disorder [12]. It can also develop in children as they grow; most often, this is seen in children who have a strong family history of diabetes, rheumatoid arthritis, Down syndrome, or other autoimmune conditions. The earlier treatment is initiated for these children, the fewer problems are encountered as they grow. Adolescents are prone to developing Hashimoto's thyroiditis, which may be a contributing cause of hypothyroidism. Overall, approximately 2 children in every 1,000 in the United States are treated for hypothyroidism [12].

EVIDENCE-BASED PRACTICE RECOMMENDATION

The American Academy of Pediatrics recommends that every infant should be tested for the detection of congenital hypothyroidism before discharge from the nursery, optimally by 48 hours to 4 days of age.

(http://www.guideline.gov/summary/summary.aspx?doc_id=9383. Last accessed September 11, 2009.)

Level of Evidence: Expert Opinion/Consensus Statement

The International Council for Control of Iodine Deficiency Disorders, or ICCIDD, has been established in an effort to eliminate iodine deficiency in developing nations [3]. They work with the World Health Organization (WHO) and the United Nations International Children's Emergency Fund (UNICEF) to develop national programs in Africa, Asia, Latin America, and Europe. The ICCIDD also seeks cooperation from the salt industry, which donates iodized salt to at-risk regions. In addition, Kiwanis International, a service club organization focusing its assistance on children 5 years of age and younger, has contributed more than $80 million toward the global elimination of iodine deficiency disorders [7].

ENVIRONMENTAL CONTRIBUTORS

One contributor to the development of hypothyroidism is perchlorate, a naturally occurring and manmade chemical that interferes with iodine uptake by the thyroid gland and can decrease production of thyroid hormones. This chemical is used in solid propellant for rockets, missiles, fireworks, and the production of matches, flares, and explosives. It has been found to contaminate the drinking water in some areas [30]. More testing is necessary to pinpoint areas of contamination and determine the significance of these findings [30].

Exposure to radiation can also lead to depression of function in the thyroid or even total loss of the gland. This may be the result of purposeful destruction of the gland, such as in certain treatments for hyperthyroidism or ablation of a tumor. In cases of accidental radiation exposure (for example, in Chernobyl), the most common long-term problem has been the development of thyroid disease. This has also been reported by healthcare workers who have been inadvertently exposed to radioactive materials.

In some cases, hypothyroidism may develop due to the excessive consumption of goitrogens, chemicals that block or interfere with the metabolism of iodine. Goitrogens are found in various concentrations in fruits and vegetables such as soybeans, peanuts, peaches, peas, strawberries, spinach, cabbage, turnips, cauliflower, sweet corn, rutabagas, radishes, and kohlrabi [33]. The moderate intake of goitrogen-rich foods is generally not associated with adverse effects unless depressed thyroid function is present.

Some medications, such as lithium and dopamine, can suppress the secretion of thyroid-stimulating hormones [26]. Some cold and sinus medicines, amiodarone, and contrast dyes given before x-rays can also interfere with normal thyroid function on a limited basis [26].

SIGNS AND SYMPTOMS

Because both T_3 and T_4 thyroid hormones increase the metabolism of proteins, fats, and carbohydrates, the lack of these hormones can cause noticeable signs and symptoms in a variety of body systems. In early and subclinical hypothyroidism, there are few symptoms. When symptoms do develop, it is often after years of thyroid dysfunction and may be attributed to other causes. Most patients do not have multiple systems involved, but some may. This is a potential factor in the misdiagnosis of hypothyroidism; if there are only a few signs present, they may be overlooked.

Fatigue, lethargy, weakness, paresthesias, depression, apathy, muscle aches or cramps, pain and stiffness in the joints, and decreased tendon reflexes are nonspecific signs of thyroid dysfunction. In patients with hypothyroidism, the pulmonary system may be affected, with a decrease in both vital capacity and total lung capacity, an increase in obstructive sleep apnea, and slower and more shallow respirations. In severe cases, this can lead to respiratory failure.

Cardiovascular changes are also common. Increased vascular resistance can result in decreased cardiac output and bradycardia, leading in turn to pericardial effusion, left ventricular enlargement, and non-specific ST changes with a prolonged QT interval. Renal vasoconstriction may lead to diastolic hypertension and decreased glomerular filtration rate, decreased tubular reabsorption of electrolytes, and peripheral edema.

Some patients may develop decreased peristalsis, leading to chronic constipation and impaired absorption of nutrients. Impaired iron absorption can cause anemia. In many hypothyroid patients, there is an unexplained weight gain despite no change in oral intake. Some patients may display hematologic changes, such as easy bruising, macrocytic anemia, or normocytic normochromic anemia.

Due to vasoconstriction associated with decreased thyroid function, the skin may become pale, jaundiced-appearing, dry, and cold. Nails become thick and brittle; hair is dry, coarse, and brittle. Hypothyroidism is one of the main causes of female hair loss [14; 16].

Reproductive problems include an increased rate of miscarriage, still birth, and fetal death [14; 16]. Women also may have menorrhagia, irregular periods, and decreased libido. When present in men, hypothyroidism can result in impotence and decreased libido.

DIAGNOSTIC TESTING

Whenever there is a suspicion of thyroid imbalance, and even routinely when there is no suspicion, laboratory testing can assist in diagnosing the condition. As noted, three hormone levels are assessed when thyroid function is being evaluated. Serum TSH levels increase when there is an underfunctioning thyroid gland. T_4 levels are normal to depressed in cases of overt or subclinical hypothyroidism. Finally, serum T_3 levels will appear as decreased in hypothyroidism.

TREATMENT

Hypothyroidism is relatively straight forward to treat. A single daily dose of levothyroxine, given as a tablet, can supplement the missing natural hormone. Treatment most commonly begins with a lower dose and increases gradually as follow-up blood tests indicate. Because most cases of hypothyroidism are permanent and progressive, it is usually necessary to receive lifelong treatment.

It is important to teach patients that they should be consistent in their use of medication. Levothyroxine should be taken at the same time daily, with a full glass of water and on an empty stomach. Various brands of the medication should not be substituted for the prescribed agent as there are slight differences among them and consistency of dosage is important.

Thyroid hormone replacement doses are based on laboratory testing rather than symptoms. Tablets are available in numerous strengths (25 mcg, 50 mcg, 75 mcg, 88 mcg, 100 mcg, 112 mcg, 125 mcg, 137 mcg, 150 mcg, 175 mcg, 200 mcg, and 300 mcg), and the typical initial oral dose is 25–100 mcg daily. This dose is increased by 50–100 mcg every 1 to 4 weeks until the desired result is achieved. The average maintenance dosage is 100–400 mcg daily; however, this may vary widely based on individual responses and needs [35].

When initiating treatment with levothyroxine, caution should be used in older patients with underlying heart disease. Patients should be instructed to notify the prescriber if their pulse is faster than 100 beats per minute at rest or if symptoms of hyperthyroidism develop. As noted, medication should be taken at the same time daily. Most patients take it upon waking in the morning. Patients taking thyroid hormone replacement therapy should avoid the use of aluminum hydroxide antacids as they may prevent full absorption [26]. Thyroid hormone can also affect the action of tricyclic antidepressants, aminophylline, theophylline, warfarin, phenytoin, carbamazepine, beta blockers, digoxin, and testosterone [13].

There have been some claims that the use of coconut oil may be a useful treatment, or even cure, for hypothyroidism. However, there is no evidence to support this use; in fact, some research suggests that coconut oil can have a negative impact on thyroid production [22]. It is important for clinicians to make their patients aware of this fallacy.

CONDITIONS ASSOCIATED WITH HYPOTHYROIDISM

Hashimoto's Thyroiditis

Hashimoto's thyroiditis, also referred to as autoimmune or chronic lymphocytic thyroiditis, is the most common cause of hypothyroidism in the United States [15]. It is estimated that 14 million Americans have this disorder. It is far more common in women than men, occurring at a ratio of 7 to 1 [15]. This autoimmune disorder destroys the thyroid gland by way of anti-thyroid antibodies. Although the immune system normally acts to protect the body from bacteria, viruses, or other foreign invaders, in this instance it attacks normal thyroid tissue. The immune system mistakenly recognizes normal thyroid cells as foreign substances and, in response, produces antibodies designed to destroy the cells. The cause of this autoimmune response is not known, although studies are underway to examine the potential role of environmental factors [19; 20].

Hashimoto's thyroiditis may be present for a number of years before symptoms appear. In many cases, the symptoms that do arise are the same as those seen in hypothyroidism; however, some symptoms occur more commonly with Hashimoto's thyroiditis, including fatigue, lethargy, forgetfulness, brittle hair and nails, increased sensitivity to medications, enlargement of the thyroid gland (goiter), constipation, sore muscles, and weight gain [15].

A routine screening, even in the absence of symptoms, may indicate an enlarged thyroid gland (on palpation) or laboratory blood testing may reveal abnormal results. The most specific test for the diagnosis of Hashimoto's thyroiditis is a blood test to detect the presence of antibodies against thyroid peroxidase, an essential thyroid enzyme. There are some cases of the disease for which the blood tests are normal. In patients with Hashimoto's thyroiditis the TSH or thyrotropin test will have an increased level, indicating hypothyroidism. The TSH rises markedly when the thyroid gland has even a small underproduction of thyroid hormone. The free T_4 level may be low if there is a deficiency of thyroid hormone in the blood. Additionally, fine-needle aspiration of a nodule may be done as part of the diagnostic work-up for Hashimoto's thyroiditis.

Several treatment options are available to assist patients with Hashimoto's thyroiditis. Thyroid hormone therapy is often used, particularly with those who have a goiter. It is usually necessary to treat this disease for a lifetime [4; 15].

Myxedema

Myxedema is a rare, and frequently fatal, complication of hypothyroidism. It is seen most often in patients who have undiagnosed or untreated hypothyroidism [21]. When patients with uncontrolled hypothyroidism are subjected to stress (e.g., infection, trauma, surgery, heart disease, seizures), they may develop full-blown myxedema or myxedema coma. Symptoms of this condition include facial and periorbital edema, thickened tongue, blank facial expression, and slowing of all motor activities. There are decreased respirations and possible respiratory acidosis. Vital signs show

bradycardia, hypothermia, and a decrease in blood pressure; heart failure is a concern. It is important to begin treatment as soon as possible, as coma and death can occur. Treatment consists of intravenous levothyroxine with glucose and corticosteroids [21]. Nursing management includes monitoring vital signs and urinary output, and close attention should be paid to the skin, as edema may cause tissue breakdown. Blankets may be necessary to combat a low body temperature. Because treatment includes thyroid supplements, it is important to be on the alert for manifestations of thyrotoxicosis, such as tachycardia, sweating, agitation, tremor, and palpitations.

HYPERTHYROIDISM

Less common than hypothyroidism, but still problematic, is hyperthyroidism. This condition is characterized by over-activity of the thyroid gland, whereby the thyroid gland produces an excess of the hormone T_4. As discussed, the rate by which T_4 and T_3 are released is controlled by the hypothalamus and the pituitary gland. The hypothalamus signals the pituitary gland to make TSH, which in turn stimulates increased production of thyroid hormone.

There are several known causes of hyperthyroidism. In 80% of cases, the autoimmune disorder Graves' disease is the source of the dysfunction [33]. Other possible causes include toxic multinodular goiter, thyroiditis (inflammation of the thyroid gland), or overdosing of thyroid replacement hormone in the treatment of hypothyroidism.

SIGNS AND SYMPTOMS

There are several observable signs that indicate the possibility of hyperthyroidism in the patient. Respiratory system manifestations include shortness of breath and increased respiratory rate and depth. Cardiovascular system changes are typically seen with a rapid, bounding pulse and/or palpitations. In addition to an increased heart rate, there may also be an increased cardiac output with possible congestive heart failure and accompanying edema. Typically, both the systolic and diastolic blood pressure are elevated 10–15 mm Hg above the patient's known normal levels. The fluid retention and decreased urinary output that occur in patients with hypothyroidism may also be seen in patients with hyperthyroidism.

Musculoskeletal system manifestations include poor coordination (secondary to tremors), muscle weakness, fatigue, and proximal muscle wasting. The disease may also affect the gastrointestinal system, with increased appetite secondary to increased peristalsis, diarrhea, and weight loss. There is accompanying vomiting with abdominal pain that can lead to malnutrition and a negative nitrogen balance.

Nervousness, anxiety, and emotional instability are frequently seen and may be accompanied by tremors. Patients may also develop heat intolerance, warm skin, and profuse sweating. Hair loss is a common complication.

Hyperthyroidism can also have adverse effects on patients' reproductive abilities. Women can experience decreased fertility, amenorrhea, or irregular periods. Hyperthyroidism is also correlated with an increased risk for spontaneous abortion [26]. As with hypothyroidism, men may develop impotence and decreased libido.

Exophthalmos (thyroid eye disease) is a frequent manifestation and is often the first sign of a thyroid imbalance. This condition will be described in greater detail later in this course.

Some patients, particularly older individuals, may have very subtle signs or symptoms, if any are present at all. The most commonly experienced symptoms in all patients are increased heart rate, heat intolerance, and fatigue. Beta blockers have also been known to mask many of the signs of hyperthyroidism [17; 23; 25].

DIAGNOSTIC TESTING

A thorough medical history and physical exam are the first steps in diagnosing hyperthyroidism. Symptoms and signs reported at this stage could have other explanations; therefore, blood tests are necessary to establish a firm diagnosis. Again, a high level of T_4 and a low or absent amount of TSH in the serum indicate an overactive thyroid.

If the blood tests are positive for hyperthyroidism, further testing may be necessary to establish the etiology of the overactive thyroid. Most commonly, this includes a radioactive iodine uptake test and/or thyroid scan.

Radioactive Iodine Uptake Test

The radioactive iodine uptake test is utilized to assess the thyroid's production of essential hormones and absorption of iodine. In this procedure, the patient is given a small oral dose of radioactive iodine. The iodine should collect in the thyroid gland, the amount of which will be measured after 2, 6, or 24 hours. A higher uptake of radioiodine indicates the thyroid gland is over-producing T_4. This is an indicator of improperly functioning nodules or Graves' disease.

Thyroid Scan

A thyroid scan may be conducted prior to biopsy. The scan involves the injection of a radioactive isotope (usually technetium). An image of the thyroid gland is taken 2 hours after injection to determine whether the gland has nodules and if it is absorbing the iodine.

TREATMENT

The three treatment options for hyperthyroidism are radiation, surgery, or thyroid-suppressing medication.

Radiation

Radiation therapy using radioactive iodine is considered the treatment of choice for most patients with hyperthyroidism. Radioactive iodine is taken orally in doses of 4 to 10 mCi given on an empty stomach. The iodine is absorbed by the thyroid gland, causing it to shrink. Ideally, hyperthyroidism symptoms will subside within 3 to 6 months. The objectives of the ablation are to make the patient's thyroid function normally or to disable it entirely, causing hypothyroidism, which can be easily treated with medication.

It is advised that patients stop all antithyroid medications for one week prior to beginning treatment with radioactive iodine and for 6 weeks after therapy ends. Radiation precautions for body secretions should be utilized for 3 days after giving the dose; close personal contact should be avoided for one week.

Ablation therapy is contraindicated during pregnancy or breastfeeding. It is the treatment preferred for the elderly or patients considered operative risks. It produces fast results with minimal adverse reactions [17; 18].

Drug Therapy

Thyroid-suppressing drugs act by interfering with thyroid synthesis, preventing iodine from combining with thyroglobulin [34]. The most frequently prescribed medications used to treat hyperthyroidism are methimazole and propylthiouracil [1]. They are not considered to be a cure, and many patients report relapses despite continual use.

Surgery

Surgical removal of the thyroid is indicated for patients who cannot or do not wish to undergo radiation therapy and who have difficulty tolerating the anti-thyroid medications. After the thyroid gland is removed, the patient will permanently require supplementary T_4 medication.

CONDITIONS ASSOCIATED WITH HYPERTHYROIDISM

Graves' Disease

The most common form of hyperthyroidism is Graves' disease, so named for the Irish physician, Robert Graves, who first recognized the condition in 1834 [33]. Graves' disease occurs more frequently in women than in men, and it most commonly occurs in patients between 20 and 40 years of age, although it can develop at any time of life. Because Graves' disease tends to be seen in families, it was first believed to have a genetic etiology; however, it is now being linked to an infectious cause [5; 33].

Thyroid Eye Disease

Thyroid eye disease (TED) is caused by inflammation of the muscles and connective tissue in the eye socket, which pushes the eyeball forward. It most commonly occurs in patients with Graves' disease [40]. Because more of the eye is exposed to the air, dryness and discomfort are common problems. Some interventions that may relieve the discomfort of TED include [33]:

- Do not smoke and avoid second-hand smoke
- Use artificial tears to maintain eye moisture
- Avoid strong sunlight
- Apply cool compresses to the eyes
- Wear wrap-around sunglasses outside (when the eyes protrude, they are more vulnerable to ultraviolet rays)
- Consume fluids in adequate amounts
- Avoid ceiling fans
- Do not use contact lenses

Thyrotoxicosis

Thyrotoxicosis, or "thyroid storm," is a serious and potentially fatal complication of hyperthyroidism. It is characterized by high body temperature, vomiting, severe tachycardia, irritability, delirium, dehydration, and an increase in clotting factor VIII. Once more common than it is today, thyrotoxicosis can be caused by serious infection, surgery, trauma, labor and delivery, pulmonary embolus, myocardial infarction, or critical metabolic problems in a patient with undiagnosed or untreated hyperthyroidism. Treatment involves addressing the precipitating condition in addition to medication to treat the severe hyperthyroid state [4; 25; 26].

THYROID NODULES

Nodules in or on the thyroid gland are fairly common. It has been estimated that 1 in 15 women and 1 in 60 men in the United States, or about 5% of the population, have thyroid nodules [33]. Nodules are ten times more common in older adults than in young people. By far the majority of nodules will turn out to be benign. Only about 25 of every million persons will be diagnosed with a malignant nodule; even malignant cases are curable 95% of the time [33].

Most nodules are found when the neck is palpated during a routine physical examination. Individuals may also notice a vague sensation of pressure in the neck or discomfort when swallowing.

Some nodules are simply an overgrowth of normal thyroid tissue. Other causes include inflammation (as with thyroiditis), fluid-filled cysts, or benign or cancerous tumors. Nodules are generally classified as [25; 27]:

- Colloid nodule (a benign overgrowth of normal thyroid tissue)
- Follicular adenoma (a benign nodule similar in appearance to follicular cancer)
- Thyroid cyst (usually benign if all fluid filled, but can be cancerous if complex or mixed with solid components)
- Inflammatory nodule (develops as the result of chronic inflammation and can cause severe pain)
- Thyroid cancer
- Multinodular goiter

Thyroid nodules are sometimes described as "hot" or "cold." Hot nodules are functional and produce thyroid hormone; they are almost never cancerous. A cold nodule is nonfunctional or inactive, producing little or no thyroid hormone. These nodules are malignant in approximately 5% of patients [27].

An open biopsy or a fine-needle aspiration may be used to determine the type of nodule. In other cases, an ultrasound may be preferred. If the nodule appears hollow on ultrasound, it is most likely a cyst. If it appears solid, the nodule may be a benign adenoma or a malignancy [33]. Open biopsy is used less frequently than fine-needle aspiration.

EVIDENCE-BASED PRACTICE RECOMMENDATION

According to the American Thyroid Association, fine-needle aspiration is the procedure of choice in the evaluation of thyroid nodules. It is recommended that all other benign thyroid nodules be followed with serial ultrasound examinations 6 to 18 months after initial fine-needle aspiration.

(http://www.guideline.gov/summary/summary.aspx?doc_id=9738. Last accessed September 11, 2009.)

Strength of Recommendation: A (Strongly recommends based on good evidence that the service or intervention can improve important health outcomes) and B (Recommends based on fair evidence that the service or intervention can improve important health outcomes)

Treatment may or may not be necessary. Nodules that appear benign may simply be watched for changes. Levothyroxine may be prescribed on the theory that it may induce a reduction in the size of the nodule and/or prevent further nodule development. If cancer is suspected, surgical removal is usually recommended [25; 27].

MULTINODULAR GOITERS

Some thyroid glands have multiple nodules, referred to as multinodular goiters; this is generally a benign condition. Multinodular goiters are most common in post-menopausal women, and although it seems illogical, goiters can be seen in both hypothyroidism and hyperthyroidism.

There are two types of goiters: endemic and sporadic. Endemic goiters occur specifically in geographic areas known as "goiter belts," which are areas with soil and water deficient in iodine. Generally, these are areas without access to salt water and seafood; historically, in the U.S. the Midwest and Great Lakes regions have been considered "goiter belts." Coastal areas have a much lower incidence of goiters.

Sporadic goiters are not associated with specific geographical locations. They are thought to be caused by one of three factors [11]:

- Abnormal iodine metabolism, probably of genetic origin
- Ingestion of large amounts of goitrogens from food sources, such as cabbage, soybeans, peanuts, peaches, peas, strawberries, radishes, rutabagas, and spinach
- Ingestion of pharmaceutical goitrogens, such as glucocorticoids, dopamine, lithium, rifampin, adrenergic antagonists, methimazole, and thiocarbanides

If goiters are diagnosed, this is an excellent opportunity for patient education regarding iodine consumption. Adults generally require a minimum of 150 mcg of iodine daily, but pregnant and breast-feeding women require an additional 100 mcg daily. Iodized salt contains 1 part iodine to 100,000 parts of salt. The average American ingests 6.2 grams of salt a day; this equates to 474 mcg of iodine if the salt is iodized [11].

THYROID CANCER

As discussed, most tumors (95%) that develop in the thyroid gland are benign, but a few are cancerous [33]. Because the thyroid gland is close to the skin, tumors often appear as bumps in the neck. Malignant nodules can develop at any age, but they are most common in adults [33]. While the majority of patients with thyroid cancer are women, nodules that develop in men are more likely to be cancerous [33]. It is estimated that approximately 25,000 people will be diagnosed with thyroid cancer this year. The public has become more aware of this malignancy due to the publicity surrounding the thyroid cancers of the late U.S. Supreme Court Chief Justice Rehnquist and movie critic Roger Ebert [9; 32].

A definitive cause of thyroid cancer has not been identified, but there are certain factors that increase the risk, including [38]:

- Exposure to radiation
- Family history
- Inherited conditions, such as familial adenomatous polyposis
- Female gender
- Women who were 30 years of age or older at their last pregnancy

CLASSIFICATION

There are several types of thyroid cancer, both differentiated and undifferentiated. Papillary and follicular carcinoma are the most common and are often grouped together to be called differentiated thyroid cancer or well-differentiated thyroid cancer [37]. Less common types are medullary carcinoma, Hurthle cell carcinoma, anaplastic carcinoma, and thyroid lymphoma.

Papillary Carcinoma

Papillary carcinoma is the most common type of thyroid cancer [37; 38]. It is also referred to as papillary cancer or papillary adenocarcinoma. It develops in the thyroid follicle cells and is very slow growing. In 10% to 20% of cases, both lobes of the thyroid gland are involved [37; 38]. There is a good prognosis with this particular cancer, and nearly all individuals with papillary cancer have good long-term survival [37; 38].

Follicular Carcinoma

Follicular carcinoma, or follicular adenocarcinoma, is the next most common type of thyroid cancer. This malignancy is less likely to spread to the lymph nodes, but the prognosis is not as good as that seen with papillary carcinoma. Still, follicular carcinoma is not likely to result in death.

Other Types

Anaplastic carcinoma, also referred to as undifferentiated thyroid cancer, is a rare form of the disease and is believed to develop from existing papillary or follicular cancer. It is extremely aggressive cancer and rapidly invades the neck and metastases to other parts of the body. Anaplastic carcinoma is rare in persons younger than 50 years of age and occurs most often in elderly patients. The associated prognosis is poor [37].

Poorly differentiated thyroid carcinoma has been defined as thyroid cancers that "retain sufficient differentiation to produce scattered follicular structures and some thyroglobulin, but generally lack the usual characteristics of papillary and follicular carcinoma" [6]. The most clearly described type of poorly differentiated thyroid carcinoma is the insular type.

Medullary thyroid carcinoma (MTC) is the only cancer that develops from the C cells of the thyroid gland. This cancer can metastasize to the lymph nodes, the lungs, or liver before the thyroid nodule has been found. There are two types of medullary thyroid cancer: sporadic and familial. Sporadic MTC accounts for 80% of cases [37]. This type of MTC is not associated with a positive family

history and occurs most often in a single lobe of the thyroid gland. Familial medullary thyroid carcinoma is seen in patients with a family history of the disease. It is often associated with pheochromocytomas.

Thyroid lymphoma is rare, but may occur. It does not develop from the C cells or from thyroid follicular cells, but rather from lymphocytes.

DIAGNOSIS

Thyroid cancer is diagnosed in several ways. The simplest test is fine-needle aspiration of the thyroid nodule. Although a blood test cannot give a definite diagnosis of cancer, it can assess the overall condition of the thyroid gland, which is helpful in determining a diagnosis. A nuclear thyroid scan, as described earlier, may be helpful not only in diagnosis of the primary tumor but also to determine metastasis. Ultrasound is an excellent non-invasive method of determining the number and size of nodules but cannot determine the pathology. Ultimately, a biopsy is required for definitive diagnosis [31; 37; 38; 39].

STAGING

Staging of thyroid cancer can help determine treatment options and predict the patient's prognosis. The American Joint Committee on Cancer (AJCC) has developed the TNM method of staging, which involves assessing three aspects of the cancer. T denotes the size of the tumor, N refers to the extent of metastasis to regional lymph nodes, and M indicates whether the cancer has metastasized to other organs (***Table 1***). After the TNM classification is complete, the carcinoma may be staged and prognosis estimated (***Table 2***, ***Table 3***, and ***Table 4***).

AMERICAN JOINT COMMISSION ON CANCER TNM CLASSIFICATION FOR THYROID CANCER	
Code	**Description**
Primary Tumor (T)*	
TX	Primary tumor cannot be assessed
T0	No evidence of primary tumor
T1	Tumor 2 cm or less in greatest dimension, limited to the thyroid
T2	Tumor larger than 2 cm but 4 cm or smaller in greatest dimension, limited to the thyroid
T3	Tumor larger than 4 cm in greatest dimension limited to the thyroid or any tumor with minimal extrathyroid extension
T4a	Tumor of any size extending beyond the thyroid capsule to invade subcutaneous soft tissues, larynx, trachea, esophagus, or recurrent laryngeal nerve
T4b	Tumor invades prevertebral fascia or encases carotid artery or mediastinal vessels
Regional Lymph Node Involvement (N)	
NX	Regional lymph nodes cannot be assessed
N0	No regional lymph node involvement
N1a	Metastasis to level VI (pretracheal, paratracheal, and prelaryngeal/Delphian lymph nodes)
N1b	Metastasis to unilateral or bilateral cervical or superior mediastinal lymph nodes
Distant Metastasis (M)	
MX	Presence of distant metastasis cannot be assessed
M0	No distant metastasis
M1	Distant metastasis is present
*All categories may be subdivided into (a) solitary tumor or (b) multifocal tumor.	
Source: [25; 37; 38; 41]	*Table 1*

PAPILLARY OR FOLLICULAR CARCINOMA STAGING AND ASSOCIATED PROGNOSIS*			
Stage	**TNM Classification**	**5-Year Survival Rate**	
		Papillary Carcinoma	**Follicular Carcinoma**
Stage I	T1, N0, M0	100%	99%
Stage II	T2, N0, M0	100%	100%
Stage III	T3, N0, M0 T1, N1a, M0 T2, N1a, M0 T3, N1a, M0	94%	82%
Stage IVA	T4a, N0, M0 T4a, N1a, M0 T1, N1b, M0 T2, N1b, M0 T3, N1b, M0 T4a, N1b, M0	48%	47%
Stage IVB	T4b, any N, M0		
Stage IVC	Any T, any N, M1		
*All stages and prognoses are for patients 45 years of age or older.			
Source: [25; 37; 38; 41]			*Table 2*

MEDULLARY CARCINOMA STAGING AND ASSOCIATED PROGNOSIS		
Stage	**TNM Classification**	**5-Year Survival Rate**
Stage I	T1, N0, M0	98%
Stage II	T2, N0, M0	98%
Stage III	T3, N0, M0 T1, N1a, M0 T2, N1a, M0 T3, N1a, M0	73%
Stage IVA	T4a, N0, M0 T4a, N1a, M0 T1, N1b, M0 T2, N1b, M0 T3, N1b, M0 T4a, N1b, M0	40%
Stage IVB	T4b, any N, M0	
Stage IVC	Any T, any N, M1	
Source: [25; 37; 38; 41]		*Table 3*

ANAPLASTIC CARCINOMA STAGING AND ASSOCIATED PROGNOSIS		
Stage*	**TNM Classification**	**5-Year Survival Rate**
Stage IVA	T4a, any N, M0	5%
Stage IVB	T4b, any N, M0	
Stage IVC	Any T, any N, M1	
*All anaplastic carcinomas are considered stage IV.		
Source: [25; 37; 38; 41]		*Table 4*

TREATMENT OPTIONS

As all cancers have become more treatable over the past decades, so has thyroid cancer. There are several treatment options available for patients diagnosed with thyroid cancer, including surgery, radioactive iodine treatment, thyroid hormone therapy, radiation therapy, alcohol ablation, and chemotherapy. Most patients will undergo a combination of these modalities.

Surgery is usually the initial treatment of choice for thyroid cancer. Total removal of the thyroid gland is often considered the best chance for survival with the lowest risk for a recurrence of the malignancy [37]. Total thyroidectomy seldom requires more than 1 to 2 days of hospitalization and affords the patient some reassurance that the cancer is under control. Chemotherapy is typically only used for anaplastic thyroid tumors or other types that have metastasized [38].

Radioactive iodine treatment destroys thyroid tissue that may be left after thyroid surgery or has metastasized beyond the thyroid gland. Thyroid hormone therapy is given to replace the hormones no longer being produced by the removed gland. It also helps to suppress the pituitary gland's production of TSH, which could encourage the growth of any remaining cancer cells.

Only rarely is radiation therapy necessary after surgery. When it is used, external beam radiation and intensity modulated radiation therapy (IMRT) are both options in the treatment of thyroid cancers. External beam radiation is aimed at the site of the cancer from outside the body. It may be used for treatment of inoperable tumors, tumors that have metastasized, or in patients for whom the risk of recurrence is great. IMRT is a more focused treatment utilizing computer-controlled x-ray accelerators. The treatment is mapped by computed tomography to ensure optimum accuracy. This limits the amount of radiation to surrounding tissue.

Alcohol ablation is being studied as a potential treatment option and is only available to patients being treated at Mayo Clinic [38]. The thyroid is injected with ethanol, which compresses the nodules and reduces the excretion of T_4. This approach is mainly used for patients with limited recurrence in the neck and is effective for tumors that cannot be treated with radioactive iodine [38].

THYROID DYSFUNCTION IN OLDER PATIENTS

As with all body systems, the endocrine system changes as a person ages. There are differences in functioning of the thyroid glands, with an associated increase in variances of symptoms of thyroid disorders and alterations in laboratory testing results.

Detection of thyroid conditions in older adults can be more difficult than in younger patients. This may be due in part to failure of the clinician to accurately recognize the patient's symptoms as potential thyroid dysfunction and instead to associate the problems with typical conditions of aging. Fatigue, forgetfulness, constipation, and hair loss are all indicative of both aging and a low functioning thyroid gland. Similarly, hyperthyroidism may cause loss of appetite, congestive heart failure, depression, dementia, muscle rigidity, nervousness, palpitations, or weakness; these signs may occur as a result of other conditions common among older adults. Therefore, the signs and symptoms of thyroid dysfunction may be difficult to diagnose and/or categorize in older patients [4; 12; 13; 33].

Treatment of thyroid dysfunction in elderly individuals is also complicated. Older patients may metabolize thyroxine more slowly than younger patients. So, when treated for hypothyroidism, these patients may require lower initial doses. It is also recommended that therapy for older adults should be titrated slowly in order to prevent untoward effects.

There is some debate as to whether or not treatment should be initiated in older adults at all. Most experts agree that patients with symptomatic dysfunction should be treated, but only with the lowest possible dosage. In asymptomatic cases, many clinicians will adopt a watchful waiting philosophy and monitor the patient but not treat immediately [4; 12; 13; 33].

Part of the reason for the hesitancy to initiate pharmacological treatment in older adults with thyroid dysfunction is the increased risk of drug interactions. Because the number of medications prescribed generally increases with age, there are more opportunities for interaction problems to develop. For example, many older women take calcium supplements to combat osteoporosis. However some studies have shown that taking levothyroxine within four hours after taking calcium carbonate can decrease the amount of thyroid hormone absorbed. It is prudent to advise patients to take these medications four hours apart. Also, there are similar studies relating to taking thyroid supplements and iron at the same time. It is recommended that these drugs be taken two or more hours apart [4; 12; 13; 33].

In addition to special considerations for diagnosis and treatment of thyroid dysfunction in the elderly population, there are several issues related to existing conditions commonly present in older adults. Hyperthyroidism is a risk factor for the development of osteoporosis; the administration of excessive amounts of thyroid-suppressing medication can lead to osteoporosis or the exacerbation of existing osteoporosis. Research has suggested that even normal doses of thyroid replacement hormone may lead to reduced bone density. Long-term treatment with 200 mcg or more of thyroid hormone has been associated with lower bone mineral density. However, there is some evidence that if TSH values are kept within the normal range, bone loss is minimized. Postmenopausal estrogen replacement therapy has also been found to offset this bone loss [4; 12; 13; 33].

MANAGEMENT OF THE PATIENT WITH THYROID DYSFUNCTION

Healthcare professionals encounter patients with thyroid disorders in virtually every possible setting, in hospitals, physician offices, the home health venue, schools, and when interacting with friends and family. Thyroid disorders are so common that it is impossible to avoid them, and healthcare professionals often are asked questions about medication or about a lump found in the neck, or they may observe that someone has developed exophthalmos.

PATIENT TEACHING

Teaching is a valuable process for the general public as well as those who have a diagnosed thyroid disease. The American Association of Clinical Endocrinologists (AACE) recommends that the public be instructed on how to examine their neck on a regular basis for lumps, nodules, or other areas of enlargement. The following assessment steps are recommended as part of the AACE's "Stick Your Neck Out, America" campaign [28]:

1. Holding a mirror in one hand, focus on the neck area just below the larynx (Adam's apple) and above the collarbone.
2. Tilt your head back.
3. Take a drink of water and swallow.
4. As you swallow, look at your neck, checking for any bulges or protrusions. This may need to be repeated several times to be sure you are looking in the correct place.
5. See a physician immediately if enlargements are seen. If there is a problem, treatment will be initiated quickly.

Patients should also be instructed regarding the necessity for iodized salt in the daily diet. Some individuals do not take iodine consumption needs into account and may routinely opt for the less expensive iodine-free salt. Also, many food manufacturers do not use iodized salt, so persons who eat predominantly processed foods, whether at home or in restaurants, may not be ingesting sufficient iodine to ward off hypothyroidism or goiter. It is important that healthcare professionals educate the public regarding this important issue.

As with any other diagnosis, patients with thyroid disease require education about their particular disease process and the importance of following a strict regimen of treatment, as outlined by their physician. Patients should have a good understanding of the medications taken to treat hypothyroidism/hyperthyroidism and how to take them correctly. Patients taking levothyroxine should be instructed to take the medication at the same time daily, on an empty stomach and with a full glass of water. Avoidance of antacids should be stressed. Those who are taking prophylthiouracil to treat hyperthyroidism should be encouraged to be strictly compliant with their regimen. Avoidance of over-the-counter cold remedies that contain iodine will be necessary. Patients should also avoid driving or other hazardous activities until they know how concentration and alertness may be affected by the drug. Signs of overmedication should be reviewed, including the necessity of contacting a physician if signs arise. Patients who have been treated with radioactive iodine must be instructed regarding radiation precautions, including abstaining from close personal contact for one week after dosing.

FOLLOW-UP ASSESSMENT

It is critical that follow-up assessments of patients should include questions regarding weight loss or gain, appetite, heat intolerance, mood swings, or any other indications of possible hypo- or hyperthyroidism. Because the patient may not be aware these points are critical, they may fail to report them without prompting. Obvious physical indications of thyroid dysfunction should also be assessed.

SURGICAL MANAGEMENT

Patients scheduled for a thyroidectomy require adequate preoperative preparation. It is not uncommon for preparation to take as long as 2 to 3 months, during which time medication will be administered to reduce the size and vascularity of the gland, decreasing the risk of postoperative hemorrhage. If possible, the patient should be well-rested, free of any infections or viral illnesses, and in overall good health.

Thyroidectomy is a treatment option for a variety of conditions, including hyperthyroidism, thyroid cancer, goiter, or nodules. Some procedures involve a simple partial removal, which leaves part of the gland available to function normally. However, others require total removal. When total removal is necessary, there is a risk of also removing or devascularizing all or part of the parathyroid glands.

Traditionally, the surgeon will remove the thyroid by making a 3- to 4-inch cut along the neck while the patient is under general anesthesia. The typical length of stay in the hospital after the procedure is 2 days. Since 1996, a laparoscopic procedure has been utilized for patients with a smaller gland or nodule. The smaller incisional length makes laparoscopic thyroidectomy an attractive option, as it is less painful in the postoperative period and has better cosmetic results; however, it is not appropriate for every patient. It is estimated that approximately 65% of patients are candidates for laparoscopic thyroidectomy [34].

For the traditional thyroidectomy patient, the caregiver should be alerted of the usual complications of any surgery, which include infection or excessive bleeding. The thyroidectomy patient is at risk for thyrotoxicosis, hypocalcemia (due to possible inadvertent removal of the parathyroid glands), respiratory obstruction, laryngeal edema, and vocal cord injury. Postoperatively, it is important to monitor vital signs and observe for bleeding. It is possible for these patients to bleed excessively, but for the blood to pool at the back of the neck, making it difficult to visualize. Also, it is recommended that a tracheotomy set, endotracheal tube,

laryngoscope, and oxygen be readily available in the event that the patient develops a complication from swelling into the respiratory tract. The patient should be instructed to deep breathe and cough, knowing that it will trigger increased pain at the surgical site. Be observant also for increased temperature or possible hypocalcemia. Assess the ability to speak. Observing serum calcium levels in the postoperative period is also helpful to verify parathyroid function.

Thyroid cancer survivors often feel somewhat isolated in their postoperative period, as they may not fit in with "typical" cancer patients or "typical" hypothyroid patients. Knowledge that thyroid hormone replacement medication will be necessary for life may cause stress for some patients.

CASE STUDY

Patient W arrived for her regular yearly physical exam. She is 60 years of age and has always been healthy and active. Patient W caught the attention of Nurse S because she was wearing a turtleneck sweater, slacks, and a light jacket, even though it was a sunny and warm day. When Nurse S asked how the patient was feeling, the answer was, "I've been trying hard to diet, but I still gained 12 pounds this past year. Maybe it's that I'm not exercising as much since my arthritis has kicked up. I've been having a lot of pain and stiffness in my joints." Further questioning revealed that Patient W had also developed chronic constipation. The physician examined the patient and ordered laboratory work to be done prior to her next visit, scheduled for 2 weeks. When the laboratory work returned, it showed an elevated TSH and a decrease in both T_3 and T_4 levels. Patient W was prescribed a starting dose of levothyroxine at 25 mcg daily. Nurse S spent time teaching the patient about taking the tablet at the same time each day with a full glass of water. Because she was not taking any other medications, there should be no problem with drug interactions; however, the patient was instructed not to take an antacid within 4 hours of taking the medication in order to avoid problems with malabsorption. A follow-up appointment was scheduled for 4 weeks with instructions to repeat the blood work 1 week prior to that appointment. At that time, medication dosages would be adjusted.

The next weekend, Nurse S went to her family reunion, where she was cornered by her cousin, Patient A, asking her advice. The cousin had noticed a hard, painless nodule near his Adam's apple. He was clearly concerned, due in part to the fact that he remembered the course of treatment his father had gone through 30 years prior for thyroid cancer. Nurse S had her cousin tilt his head back, then looked at his throat area while he swallowed some iced tea. She clearly saw a lump protruding prominently from the neck area. She advised him to call his physician for an appointment as soon as possible to be checked out. She told him to expect to have blood work drawn and an ultrasound of the thyroid.

Patient A followed Nurse S's advice and called her 2 weeks after he had seen the doctor and had the diagnostic work done. The ultrasound had showed nodules, so a biopsy was arranged. When it returned from the pathologist, the biopsy was positive for papillary adenocarcinoma. A total thyroidectomy was done, and Patient A had an uneventful recovery. Pathology showed no metastasis to lymph glands, so he did not have to face a difficult course of treatment like his father had.

The next week at work in the office, there was a problem with the air conditioning unit. The temperature was uncomfortably cold for most patients. However, Patient C, who had come to the office for a work-related physical exam, complained of being hot. She was wearing a sleeveless blouse and was fanning herself despite the cool room. At 27 years of age, Nurse S felt it was unlikely that Patient C was suffering from menopause, so she mentioned the symptom in her notes for the physician. The patient's measured weight was 116 pounds, which she reported was a loss of 12 pounds. She had not been dieting and reported feeling nervous and restless lately, which she attributed to a recent miscarriage.

When the nurse reported these findings to the physician, he ordered TSH, T_3, and T_4 levels to be drawn. At the follow-up appointment, results from the blood studies showed a decrease in TSH and an increase in both the T_3 and T_4. All indications were for a diagnosis of hyperthyroidism.

The patient was prescribed methimazole, the thyroid-suppressing medication. In addition, the physician indicated that if there was no improvement in 1 month he would order a thyroid scan. Fortunately, like most patients, Patient C responded positively to treatment with the methimazole, and 1 year later she returned for follow-up with her baby boy.

CONCLUSION

The thyroid gland is a small but very vital member of the endocrine system. Tiny alterations in its function can adversely affect patients' daily lives. Most healthcare professionals frequently encounter patients with some sort of thyroid dysfunction. Whether it is hypothyroidism, hyperthyroidism, or thyroid cancer, many patients are dealing with the treatment of thyroid dysfunction.

Healthcare professionals must be aware of the signs and symptoms of thyroid dysfunction so they may appropriately identify the conditions in their patients. Early and accurate diagnosis results in early initiation of treatment and better patient outcomes.

RESOURCES

This list of resources may be helpful for healthcare professionals and patients. They are groups and agencies that have information available for people with thyroid cancer or any other thyroid condition.

American Association of Clinical Endocrinologists
245 Riverside Avenue, Suite 200
Jacksonville, FL 32202
904-353-7878
http://www.aace.com

American Thyroid Association
6066 Leesburg Pike, Suite 550
Falls Church, VA 22041
703-998-8890 or 1-800-THYROID
http://www.thyroid.org

Graves' Disease Foundation
400 International Drive
Williamsville, NY 14221
1-877-643-3123
http://www.ngdf.org

The Thyroid Cancer Survivors' Association, Inc. (ThyCa, Inc.)
P.O. Box 1545
New York, NY 10159
1-877-588-7904
http://www.thyca.org

GLOSSARY OF TERMS

Cold nodule: A nodule with little or no thyroid hormone production, resulting in less radioactive material uptake when a scan is performed. May indicate cancer.

Euthyroid: A normally functioning thyroid gland.

Exophthalmos: Bulging eyes seen in patients with hyperthyroidism.

Fine-needle aspiration: A diagnostic procedure whereby a thin needle is used to remove fluid and cells from a nodule to be sent to the pathology laboratory for diagnosis.

Goiter: An enlarged thyroid gland.

Goiter belt: A term used to describe geographical areas where there are insufficient natural sources of iodine available for consumption, causing a higher rate of hypothyroidism.

Goitrogens: Substances that block or interfere with iodine absorption.

Graves' disease: A condition causing over-production of thyroid hormone, resulting in hyperthyroidism.

Hashimoto's thyroiditis: An autoimmune disorder in which abnormal antibodies attack the thyroid gland and cause hypothyroidism.

Hot nodule: A nodule that continues to produce thyroid hormone and takes up more radioactive material when a scan is performed. Seldom cancerous.

Hyperthyroidism: Condition characterized by excess thyroid hormone production.

Hypothyroidism: Condition characterized by insufficient thyroid hormone production.

Multinodular goiter: The presence of numerous nodules on the thyroid gland, which interferes with normal thyroid function.

Myxedema: A form of cutaneous and dermal edema caused by severely decreased thyroid hormone available for use in the body.

Nontoxic multinodular goiter: The presence of multiple nodules on a goiter, but without interference with normal hormone production.

Subacute viral thyroiditis: A flu-like condition, probably viral in origin, that causes the thyroid gland to swell and become very tender.

Thyroxine (T_4): A hormone produced by the thyroid gland involved in regulating metabolic processes and physical development.

Triiodothyronine (T_3): A hormone produced by the thyroid gland with very wide effects, including on the autonomic nervous system.

Thyroid-stimulating hormone (TSH): A hormone secreted by the pituitary gland to stimulate the thyroid gland to secrete T_4 and T_3.

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