Thyroid Dysfunction

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Faculty

Marilyn Fuller Delong, MA, BSN, RN, received her basic nursing education at St. Luke's School of Nursing in Cedar Rapids, Iowa, her BSN from Coe College and her MA from California State University, Long Beach. She has worked throughout the United States both clinically and as an educator. Her continuing education classes have focused on the case management aspects of the care of orthopedic and pulmonary patients, with particular focus on the long-term care needs of the elderly and disabled.

Faculty Disclosure

Contributing faculty, Marilyn Fuller Delong, MA, BSN, RN, has disclosed no relevant financial relationship with any product manufacturer or service provider mentioned.

Division Planner

Jane C. Norman, RN, MSN, CNE, PhD

Director of Development and Academic Affairs

Sarah Campbell

Division Planner/Director Disclosure

The division planner and director have disclosed no relevant financial relationship with any product manufacturer or service provider mentioned.

Audience

This course is designed for nurses, allied surgical professionals, and other healthcare workers in all practice settings who may care for patients with thyroid dysfunction.

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

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

More than 20 million people in the United States have some type of thyroid dysfunction (greater than the number of Americans with cancer); however, up to 60% of those with thyroid dysfunction are unaware of their condition [1; 2]. Approximately 4.6% of Americans have hypothyroidism, and approximately 1.2% have hyperthyroidism [3; 4]. These statistics indicate that nurses and other healthcare workers are likely to encounter thyroid dysfunctional patients every day. 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 thyroid gland is part of the endocrine system, which is composed of multiple glands that control all body systems. When one gland in the endocrine system malfunctions, it has a cascading 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 part of the body.

ANATOMY AND 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. Often embedded behind the four corners, or points, of the H shape are the parathyroid glands; in some cases, parathyroid glands may be found in the subglandular fat of 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 muscles as well as the heart, liver, 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 redeploys 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 [5]. 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 [6].

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 genetic factors, age, smoking status, 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 thyroiditis [7; 65].

As mentioned, thyroid disease affects more than 20 million Americans and is frequently undiagnosed. Women are five to eight times more likely to have thyroid problems than men [2]. 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 [8; 66].

Within the United States and other industrialized nations, iodine is usually 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 many developing countries, it is much harder for individuals to consume the necessary amount of iodine, as many people simply do not have access to adequate dietary sources (e.g., iodized salt, seafood, seaweed, livestock/dairy products from animals given iodine-supplemented feed). In some parts of the world, iodine deficiency remains a very serious problem [9; 10]. Iodine deficiency-related hypothyroidism is not limited to adults. Thyroid hormones are essential for fetal brain growth and development. Severe maternal iodine deficiency may lead to mental and growth retardation in offspring. Even mild maternal iodine deficiency has been associated with lower IQ in children [11]. International data from countries with well-established newborn screening programs indicate an incidence of congenital hypothyroidism of about 1 per 3,000 to 4,000 [12].

In the United States, newborns are screened at birth for the presence of congenital hypothyroidism with a simple blood test [13; 14]. One out of every 1,500 infants in the United States is born with this disorder, a number that has almost doubled in recent years, possibly due to an increase in congenital hypothyroidism with thyroid gland in-situ, lower TSH screening cutoffs, altered ethnicities of the screened population, and increased multiple and premature births [12]. Congenital hypothyroidism 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 thyroiditis, which may be a contributing cause of hypothyroidism.

The International Union of Nutritional Sciences Iodine Global Network (IUNS/IGN) (formerly the International Council for Control of Iodine Deficiency Disorders [ICCIDD]) has been established in an effort to eliminate iodine deficiency in developing nations [15]. The IUNS/IGN works 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 IUNS/IGN 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 $105 million toward the global elimination of iodine deficiency disorders [9].

ENVIRONMENTAL CONTRIBUTORS

One contributor to the development of hypothyroidism is perchlorate, a naturally occurring and man-made 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 in the production of matches, flares, and explosives. It has been found to contaminate the drinking water in some areas [16]. More testing is necessary to pinpoint areas of contamination and determine the significance of these findings [16].

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 (e.g., 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 [7]. 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 [17]. Some cold and sinus medicines, amiodarone, and contrast dyes given before x-rays can also interfere with normal thyroid function on a limited basis [17].

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, paresthesia, 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, shallower 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 nonspecific 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 [18; 19].

Reproductive problems include an increased rate of miscarriage, stillbirth, and fetal death [18]. 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 [19].

TREATMENT

Treatment for hypothyroidism is relatively straightforward. A single daily dose of levothyroxine, given as a tablet, can supplement the missing natural hormone [18]. 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.

EVIDENCE-BASED PRACTICE RECOMMENDATION

The American Thyroid Association asserts that levothyroxine is recommended as the preparation of choice for the treatment of hypothyroidism due to its efficacy in resolving the symptoms of hypothyroidism, long-term experience of its benefits, favorable side effect profile, ease of administration, good intestinal absorption, long serum half-life, and low cost.

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Strength of Recommendation/Level of Evidence: Strong recommendation, moderate-quality evidence

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 (i.e., 25 mcg, 50 mcg, 75 mcg, 88 mcg, 100 mcg, 112 mcg, 125 mcg, 137 mcg, 150 mcg, 175 mcg, 200 mcg, 300 mcg), and the typical initial oral dose is less than 200 mcg daily. This dose is increased by 50–100 mcg every one to four weeks until the desired result is achieved. Doses greater than 300 mcg per day are rare [20; 21].

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 [17; 21]. Thyroid hormone can also affect the action of tricyclic antidepressants, aminophylline, theophylline, warfarin, phenytoin, carbamazepine, beta blockers, digoxin, and testosterone [21; 22].

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 [23]. It is important for clinicians to make their patients aware of this fallacy.

CONDITIONS ASSOCIATED WITH HYPOTHYROIDISM

Hashimoto Thyroiditis

Hashimoto thyroiditis, also referred to as autoimmune or chronic lymphocytic thyroiditis, is the most common cause of hypothyroidism in the United States in patients 6 years of age and older [24]. It is estimated that 14 million Americans have this disorder. It is 10 to 15 times more common in women than men [24]. This autoimmune disorder destroys the thyroid gland by way of antithyroid 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 hereditary and environmental factors [25; 26; 67].

Hashimoto 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 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 [24; 27].

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 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 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 thyroiditis to exclude malignancy or the presence of a thyroid lymphoma in fast-growing thyroid goiters [27].

Several treatment options are available to assist patients with Hashimoto thyroiditis. Thyroid hormone therapy with levothyroxine sodium is the treatment of choice, particularly with those who have a goiter. It is usually necessary to treat this disease for a lifetime [24; 27; 28].

Myxedema

Myxedema is a rare, and frequently fatal, complication of hypothyroidism. It is seen most often in patients who have undiagnosed or untreated hypothyroidism [29]. 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 [29; 68]. 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 [68].

HYPERTHYROIDISM

Less common than hypothyroidism, but still problematic, is hyperthyroidism. This condition is characterized by overactivity 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 60% to 80% of cases, the autoimmune disorder Graves disease is the source of the dysfunction [7; 30]. Other possible causes include toxic multinodular goiter (15% to 20% of cases), toxic adenoma (3% to 5% of cases), thyroiditis (inflammation of the thyroid gland), or overdosing of thyroid replacement hormone in the treatment of hypothyroidism [30].

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 pressures 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 [30].

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 [30].

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 [30].

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 [17]. As with hypothyroidism, men may develop impotence and decreased libido.

Exophthalmos (i.e., abnormal protrusion of the eyeball) 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 [31; 32; 33].

DIAGNOSTIC TESTING

According to a guideline from the American Thyroid Association (ATA), a thorough medical history and physical exam are the first steps in diagnosing hyperthyroidism [34]. This should include measurement of pulse rate, blood pressure, respiratory rate, body weight, and an assessment of pulmonary, cardiac, and neuromuscular function. Thyroid size, symmetry, nodularity, and presence or absence of thyroid tenderness should also be assessed [34].

Symptoms and signs reported at this stage could have other explanations, particularly in the elderly; therefore, blood tests are necessary to establish a firm diagnosis. When hyperthyroidism is strongly suspected, diagnostic accuracy improves when both a serum TSH, free T_4, and total T_3 are assessed at the time of initial evaluation [34]. Again, a high level of T_4 and a low or absent amount of TSH in the serum indicate an overactive thyroid [30]. In mild hyperthyroidism, free T_4 may be normal, with low or absent amounts of TSH in the serum, and only serum T_3 may be elevated [34]. Biotin supplements can interfere with the results of TSH blood tests. Patients should be asked if they take biotin or multivitamin supplements and should be advised to avoid taking a supplement containing biotin for at least 12 hours prior to testing [31].

If the blood tests are positive for hyperthyroidism, further testing may be necessary to establish the etiology of the overactive thyroid [34]. Most commonly, this includes a radioactive iodine uptake test, a thyrotropin receptor autoantibody (TRAb) test, and/or thyroid scan [30; 31].

Radioactive Iodine Uptake Test

The ATA guideline recommends that a radioactive iodine uptake test be performed when the diagnosis is in question (except during pregnancy) [34]. Prior to administering the test, medical therapy of any comorbid conditions should be optimized [34].

The radioactive iodine uptake test is used 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 overproducing T_4. This is an indicator of improperly functioning nodules or Graves disease [31].

Thyroid Scan

The ATA guideline recommends that a thyroid scan be added in the presence of thyroid nodularity [34]. Thyroid scan may be conducted prior to biopsy and involves the injection of a radioactive isotope (usually technetium). An image of the thyroid gland is taken two hours after injection to determine whether the gland has nodules and if it is absorbing the iodine.

Thyrotropin Receptor Autoantibody (TRAb) Test

The ATA guideline and the Mayo Clinic recommend TRAb testing as an option for establishing a definitive diagnosis when clinical findings are ambiguous and/or when Graves disease is suspected but thyroid function tests are normal [34; 73]. TRAb testing is particularly useful when radioactive iodine uptake testing is contraindicated, as in patients who are pregnant or breastfeeding. Other specific examples of TRAb test use in pregnant patients include determining the risk of neonatal thyrotoxicosis in a fetus of a patient with Graves disease, and the differential diagnosis of gestational thyrotoxicosis versus first trimester manifestation or recurrence of Graves disease [73]. TRAb testing is strongly recommended to guide medication treatment decisions [34].

TREATMENT

The three treatment options for hyperthyroidism are radiation, surgery, and thyroid-suppressing medication. Symptom relief is an important component of treatment. The choice of treatment depends upon the patient's age, physical condition, and severity of disease [30; 31; 34].

Radiation

Radiation therapy using radioactive iodine (also referred to as radioiodine ablation) is considered the treatment of choice for most patients with hyperthyroidism. The effect of treatment with radioactive iodine is less rapid than either drug therapy or surgery; however, it is both safe and effective and does not require hospitalization [30]. Radioactive iodine is taken orally in doses of 4–10 mCi given on an empty stomach. The iodine is absorbed by the thyroid gland, causing it to shrink. Ideally, hyperthyroidism symptoms will subside within three to six months. The objectives of radioiodine ablation are to make the patient's thyroid function normally or to disable it entirely, causing hypothyroidism, which can be easily treated with medication [30; 31].

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

Ablation therapy is contraindicated during pregnancy or breastfeeding and is not recommended for use in children younger than 5 years of age; long-term antithyroid medications are preferred in this patient population [30; 36]. Ablation therapy is the treatment preferred for the elderly or for patients considered operative risks. It produces fast results with minimal adverse reactions [30; 31].

Drug Therapy

Two main types of medications are used to treat patients with hyperthyroidism—thyroid-suppressors and beta-blockers. Thyroid-suppressing drugs act by interfering with thyroid synthesis, preventing iodine from combining with thyroglobulin [30; 35]. The most frequently prescribed medications used to treat hyperthyroidism are methimazole and propylthiouracil [21; 30; 34]. The U.S. Food and Drug Administration added a boxed warning to the labeling for propylthiouracil due to reports of severe liver injury and acute liver failure, some cases of which have been fatal. It is recommended that the drug be reserved for patients who cannot tolerate other treatments (e.g., methimazole, radioactive iodine, surgery) [21; 30]. Neither methimazole nor propylthiouracil are considered to be a cure, and many patients report relapses despite continual use.

Beta-blockers do not modulate the disease itself; instead, they are used to treat various symptoms of hyperthyroidism, including anxiety, heat intolerance, palpitations, tachycardia, and tremors [74]. The use of beta-blockers is recommended in the ATA treatment guideline as first-line therapy for all patients with symptomatic thyrotoxicosis, but especially for those with comorbid cardiovascular disease, a resting heart rate greater than 90 beats per minute, and elderly patients [34]. Atenolol, metoprolol, nadolol, and propanolol are a few of the ATA recommended beta-blockers, and the guideline notes that while these medications have not been specifically approved for hyperthyroidism, they are approved for the treatment of cardiovascular disease. Beta-blocking agents are contraindicated in individuals with bronchospastic asthma. Patients treated with thyroid-suppressors and beta-blockers have been shown to have less fatigue and shortness of breath, lower heart rates, and better self-reported overall functioning compared with patients taking thyroid-suppressors alone [34].

Surgery

Surgical removal of a portion or the entire thyroid is indicated for patients who cannot or do not wish to undergo radiation therapy and who have difficulty tolerating the antithyroid medications. Preoperative care includes administration of antithyroid medication, stable (i.e., cold) iodine treatment (to decrease gland vascularity), and beta-blocker therapy [30]. After the thyroid gland is removed, the patient will permanently require supplementary T_4 medication [30; 34].

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 [7; 37]. Graves disease occurs more frequently in women than in men and most commonly 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 thought that a genetic susceptibility is triggered by an infectious cause (e.g., viral infection) [7; 37; 38].

According to the American Thyroid Association, patients with overt Graves' hyperthyroidism should be treated with any of the following modalities: radioactive iodine therapy, antithyroid drug therapy, or thyroidectomy.

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Strength of Recommendation/Level of Evidence: Strong recommendation, moderate-quality evidence

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 (i.e., proptosis). It most commonly occurs in patients with Graves disease [37; 39]. Because more of the eye is exposed to the air, dryness and discomfort are common problems. Some interventions that may relieve the discomfort of mild-to-moderate TED include [7; 47]:

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

In 2020, the U.S. Food and Drug Administration approved teprotumumab, the first medication for the treatment of thyroid eye disease [72]. This monoclonal antibody therapy is administered as an IV infusion every three weeks. A small 2020 randomized, placebo-controlled, phase 3 trial found that proptosis was significantly reduced in the treatment vs. placebo group (78% response vs. 7% response) [75]. Proptosis was reduced by nearly 3 mm with teprotumumab, and quality of life scores were greatly improved; several adverse events occurred but were mild or moderate.

Standard treatment for individuals with moderate-to-severe TED is a course of pulse doses of IV methylprednisolone [47]. Proptosis is typically reduced to manageable levels within four weeks to six months of steroid treatment and within one to two years of initiation of anti-thyroid medication. Some patients whose condition does not improve with medication may require orbital decompression surgery

[47]. Thyroidectomy will resolve TED within one year; many patients prefer this option over orbital decompression surgery. Radioactive iodine therapy is known to exasperate TED and should be avoided in patients with moderate-to-severe eye disease [47].

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 and administering medication to treat the severe hyperthyroid state [17; 28; 33; 37].

THYROID NODULES

Nodules in or on the thyroid gland are fairly common. The estimated lifetime risk for developing thyroid nodules is 5% to 10%; however, newer, high-resolution ultrasound has revealed thyroid nodules in 19% to 68% of randomly selected individuals in one study, suggesting a higher rate of detectable nodules due to newer diagnostic methods [7; 40]. Nodules are 10 times more common in older adults than in young people and are more common in women than men [40]. The majority of nodules will turn out to be benign, with only 7% to 15% being malignant nodules; even malignant cases are curable 95% of the time [7; 40].

Most nodules are initially 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 [33; 40]:

- 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

While imaging studies are no longer routinely used as part of the initial diagnostic evaluation of solitary thyroid nodules, nuclear imaging can be used to describe thyroid nodules 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% to 8% of patients [40]. Ultrasound is highly sensitive in determining the size and number of thyroid nodules; however, it cannot reliably be used alone to distinguish between a benign and a malignant nodule. It may be helpful in some cases when it is used to guide fine-needle aspiration biopsy [40].

THE 2017 BETHESDA SYSTEM FOR REPORTING THYROID CYTOPATHOLOGY			
Diagnostic Category	**Risk of Malignancy if NIFTP IS NOT Considered Carcinoma**	**Risk of Malignancy if NIFTP IS Considered Carcinoma**	**Management**
Benign	0% to 3%	0% to 3%	Clinical and sonographic follow-up
AUS/FLUS[a]	6% to 18%	10% to 30%	Repeat FNA, molecular testing, or lobectomy
Follicular neoplasm	10% to 40%	25% to 40%	Molecular testing, lobectomy
Suspicious for malignancy	45% to 60%	50% to 75%	Possible near-total thyroidectomy or lobectomy
Malignancy	94% to 96%	97% to 99%	Possible near-total thyroidectomy or lobectomy
Nondiagnostic or unsatisfactory	5% to 10%	5% to 10%	Repeat FNA with ultrasound
AUS = atypia of undetermined significance, FNA = fine-needle aspiration, FLUS = follicular lesion of undetermined significance, NIFTP = noninvasive follicular thyroid neoplasm with papillary-like nuclear features. [a]AUS and FLUS are considered synonymous.			
Source: [69]			*Table 1*

EVIDENCE-BASED PRACTICE RECOMMENDATION

According to the American Thyroid Association, thyroid cancers should be staged with imaging; this is best done with (18)F-fluorodeoxyglucose (FDG) positron emission tomography/computed tomography (CT) and/or alternatively with dedicated body CT or MRI. The extent of local invasion should also be evaluated in parallel to assist in surgical decision-making, and this requires laryngoscopy.

(https://www.liebertpub.com/doi/full/10.1089/thy.2020.0944. Last accessed September 28, 2021.)

Strength of Recommendation/Level of Evidence: Strong recommendation, moderate-quality evidence

An open biopsy or a fine-needle aspiration biopsy is an important step in determining the type of nodule. Fine-needle aspiration biopsy has been demonstrated to be highly accurate (i.e., mean sensitivity greater than 80% and mean specificity greater than 90%). Routine use of fine-needle aspiration biopsy in diagnostic evaluation can reduce the need for diagnostic thyroidectomy by 20% to 50% [40].

To improve the clarity and consistency of thyroid cytopathology, the National Cancer Institute convened a conference in 2007 that led to the development of the Bethesda System for Reporting Thyroid Cytopathology (TBSRTC). In 2017, the TBSRTC was updated to include reclassification of some thyroid neoplasms as noninvasive follicular thyroid neoplasm with papillary-like nuclear features (NIFTP), which has implications for the risk of malignancy. The diagnostic categories, associated respective risk of malignancy of NIFTP without malignancy and those considered as carcinoma, and recommended management, are detailed in ***Table 1*** [69].

As noted, 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 [33; 40; 69].

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 postmenopausal 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 goiter is defined as thyroid enlargement that occurs in more than 10% of a population [41]. 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 United States, the Midwest and Great Lakes regions have been considered "goiter belts." Coastal areas have a much lower incidence of goiters.

Sporadic goiters (more common in the United States) are a result of environmental or genetic factors that do not affect the general population and are not associated with specific geographical locations [41]. Although the cause of sporadic goiter is usually unknown, they are thought to be the result of [41; 42]:

- 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 thiocarbamates

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 breastfeeding 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 [42].

THYROID CANCER

As discussed, most tumors (95%) that develop in the thyroid gland are benign, but a few are cancerous [7]. 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 [7]. While the majority of less aggressive histologic subtypes of thyroid cancer are more common in women than in men, the more aggressive subtypes have similar gender distribution [43; 44]. It is estimated that approximately 44,280 people (28,780 women and 15,500 men) will be diagnosed with thyroid cancer in 2021. The median age at diagnosis is 51 years [45; 46].

A definitive cause of thyroid cancer has not been identified, but there are certain factors that increase the risk, including [48; 49]:

- Exposure to high levels of 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. Hürthle cell carcinoma is a subtype of follicular carcinoma, accounting for approximately 3% of all thyroid cancers [50]. Other less common types are medullary carcinoma (4%); anaplastic carcinoma (2%); and thyroid lymphoma, thyroid sarcomas, or other rare tumors (4%).

Papillary Carcinoma

Papillary carcinoma is the most common type of thyroid cancer, accounting for about 80% of thyroid malignancies [48; 50]. 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 [48; 50]. There is a good prognosis with this particular cancer, and nearly all individuals with papillary cancer have good long-term survival [48; 50].

Follicular Carcinoma

Follicular carcinoma, or follicular adenocarcinoma, is the next most common type of thyroid cancer, although it is much less common than papillary thyroid cancer, making up about 10% of thyroid cancers [50]. 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 [50].

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 [50].

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" [51]. 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. The sporadic type accounts for 80% of MTC cases [50]. 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 [50]. It is often associated with pheochromocytomas [49].

Thyroid lymphoma is rare, but may occur. It does not develop from the C cells or from thyroid follicular cells, but rather from lymphocytes. Thyroid sarcoma is also rare. It begins in the supporting cells of the thyroid and is usually aggressive and difficult to treat [50].

DIAGNOSIS

Thyroid cancer is diagnosed in several ways. The simplest test is fine-needle aspiration of the thyroid nodule. Although a blood test cannot provide 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 both in diagnosis of the primary tumor and in determining metastasis. Ultrasound is an excellent noninvasive method of determining the number and size of nodules but cannot determine the pathology. Ultimately, a biopsy is required for definitive diagnosis [48; 52; 53].

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 2***). After the TNM classification is complete, the carcinoma may be staged and prognosis estimated (***Table 3***, ***Table 4***, and ***Table 5***) [70].

AMERICAN JOINT COMMITTEE ON CANCER TNM CLASSIFICATION FOR THYROID CANCER	
Code	**Description**
Primary Tumor (T)[a]	
TX	Primary tumor cannot be assessed
T0	No evidence of primary tumor
T1a	Tumor 1 cm or less in greatest dimension, limited to the thyroid
T1b	Tumor larger than 1 cm but not larger than 2 cm 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 (non-anaplastic)	Tumor of any size extending beyond the thyroid capsule to invade subcutaneous soft tissues, larynx, trachea, esophagus, or recurrent laryngeal nerve
T4a (anaplastic)	Tumor limited to the thyroid
T4b (non-anaplastic)	Tumor invades prevertebral fascia or encases carotid artery or mediastinal vessels
T4b (anaplastic)	Tumor has extended beyond the thyroid
Regional Lymph Node Involvement (N)	
NX	Regional lymph nodes cannot be assessed
N0	No regional lymph node involvement
N0a	One or more cytologically or histologically confirmed benign lymph node
N0b	No radiologic or clinical evidence of locoregional lymph node metastasis
N1	Metastasis to regional lymph nodes
N1a	Metastasis to level VI or VII (pretracheal, paratracheal, and prelaryngeal/Delphian, or upper mediastinal lymph nodes)
N1b	Metastasis to unilateral or bilateral cervical, retropharyngeal, or superior mediastinal lymph nodes
Distant Metastasis (M)	
MX	Distant metastasis cannot be assessed
M0	No distant metastasis
M1	Distant metastasis is present
[a]All categories may be subdivided into (a) solitary tumor or (b) multifocal tumor.	
Source: [33; 48; 54; 55; 70]	*Table 2*

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, and chemotherapy. Most patients will undergo a combination of these modalities [57].

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 [57]. Total thyroidectomy seldom requires more than one to two 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 [58].

PAPILLARY OR FOLLICULAR CARCINOMA STAGING AND ASSOCIATED PROGNOSIS[a]			
Stage	**TNM Classification**	**Five-Year Survival Rate**	
		Papillary Carcinoma	**Follicular Carcinoma**
Stage I	T1, N0/NX, M0 T2, N0/NX, M0	Nearly 100%	Nearly 100%
Stage II	T1, N1, M0 T2, N1, M0 T3a/T3b, any N, M0	Nearly 100%	Nearly 100%
Stage III	T4a, any N, M0	93%	71%
Stage IVA	T4b, any N, M0	51%	50%
Stage IVB	Any T, any N, M1		
[a]All stages and prognoses are for patients 55 years of age or older.			
Source: [33; 55; 56; 70]			*Table 3*

MEDULLARY CARCINOMA STAGING AND ASSOCIATED PROGNOSIS		
Stage	**TNM Classification**	**Five-Year Survival Rate**
Stage I	T1, N0, M0	Nearly 100%
Stage II	T2, N0, M0 T3, N0, M0	98%
Stage III	T1-3, N1a, M0	81%
Stage IVA	T4a, any N, M0 T1-3, N1b, M0	28%
Stage IVB	T4b, any N, M0	
Stage IVC	Any T, any N, M1	
Source: [33; 55; 56]		*Table 4*

ANAPLASTIC CARCINOMA STAGING AND ASSOCIATED PROGNOSIS[a]		
Stage	**TNM Classification**	**Five-Year Survival Rate**
Stage IVA	T1-3a, N0/NX, M0	7%
Stage IVB	T1-3a, N1, M0 T3b, any N, M0 T4, any N, M0	
Stage IVC	Any T, any N, M1	
[a]All anaplastic carcinomas are considered stage IV.		
Source: [33; 55; 56]		*Table 5*

Radioactive iodine treatment destroys thyroid tissue that may be left after thyroid surgery or has metastasized beyond the thyroid gland [57]. 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. Radioactive iodine therapy has been shown to improve the survival rate of patients with papillary or follicular thyroid cancer that has spread to the neck or other body parts [59].

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 medullary or anaplastic thyroid cancers [60]. 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 using 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.

Physicians at the Mayo Clinic pioneered ultrasound-guided alcohol ablation treatment for recurring thyroid cancers [48]. The thyroid is injected with ethanol, which compresses the nodules and reduces the excretion of T4. 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 or for tumors that are difficult to reach surgically [48].

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 [7; 22; 28].

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 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 [7; 22; 28].

Part of the reason for the hesitancy to initiate pharmacologic 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 [7; 22; 28].

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 [7; 22; 28].

MANAGEMENT OF THE PATIENT WITH THYROID DYSFUNCTION

Healthcare professionals encounter patients with thyroid disorders in virtually every possible setting, including 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 for those who have a diagnosed thyroid disease. The AACE recommends that the public be instructed on how to examine the 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 annual thyroid awareness campaign [61]:

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 propylthiouracil 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 should 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 that these symptoms are critical, he/she 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 two to three 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 partial removal (subtotal thyroidectomy or lobectomy), which leaves part of the gland available to function normally [62]. 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 incision along the neck while the patient is under general anesthesia. The typical length of stay in the hospital after the procedure is about one day [62]. Since 1996, an endoscopic procedure has been used for patients with a smaller gland or nodule, and advancements have led to several minimally invasive techniques, including robotic, video-assisted, and transoral approaches [71]. The smaller incisional length of approximately 3 cm makes endoscopic thyroidectomy an attractive option, as it is less painful in the postoperative period and has better cosmetic results. It may additionally help in identifying structures and in minimizing the incision; however, it is not appropriate for every patient [63]. It is estimated that approximately 65% of patients are candidates for laparoscopic thyroidectomy [35; 71]. Postoperative morbidity rates in patients who have undergone laparoscopic thyroidectomy are equivalent to rates in patients who have undergone conventional surgery, although it is necessary that qualified practitioners have a thorough knowledge of underlying pathology and experience with this method [63; 71].

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 [63]. 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 breathe deeply and cough, knowing that it will trigger increased pain at the surgical site. Be observant also for increased temperature or possible hypocalcemia. Observing serum calcium levels in the postoperative period is also helpful to verify parathyroid function [63].

It is also important to assess the ability to speak. In 2013, the American Academy of Otolaryngology issued a new guideline designed to highlight the importance of a patient's voice in the physical examination [64]. This guideline includes a strong recommendation that clinicians performing thyroid surgery identify the recurrent laryngeal nerve or nerves. The guideline also recommends a presurgical assessment of the patient's voice and vocal fold mobility and emphasizes the importance of patient education regarding possible effects of thyroid surgery on the patient's voice [64].

Other new technologies include the electrothermal bipolar vessel sealing system and ultrasonic dissectors [63]. The electrothermal bipolar vessel sealing system delivers a precise amount of energy, minimizing spread to adjacent tissues and critical structures (e.g., parathyroid glands, recurrent laryngeal nerve). Studies have suggested that electrothermal bipolar vessel sealing results in shorter operating time and decreased postoperative stay compared to conventional surgery [63]. Ultrasonic dissection uses ultrasonic motion to create heat and coagulate resultant proteins, decreasing thermal injury to surrounding tissue. Less manipulation of thyroid tissue also results in decreased inflammation. Studies have suggested that ultrasonic dissection decreases operating time by 10% to 35% and leads to shorter hospital stays and less risk of intraoperative and postoperative bleeding [63].

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 two 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 four hours of taking the medication in order to avoid problems with malabsorption. A follow-up appointment was scheduled for four weeks with instructions to repeat the blood work one 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 two 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 one month, he would order a thyroid scan. Fortunately, like most patients, Patient C responded positively to treatment with the methimazole, and one year later she returned for follow-up with her baby boy.

CONCLUSION

The thyroid gland is a small but 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 should 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
https://www.aace.com

American Thyroid Association
https://www.thyroid.org

Graves Disease and Thyroid Foundation
https://www.gdatf.org

Thyroid Cancer Survivors' Association, Inc. (ThyCa, Inc.)
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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 overproduction of thyroid hormone, resulting in hyperthyroidism.

Hashimoto 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.

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.

Implicit Bias in Health Care

The role of implicit biases on healthcare outcomes has become a concern, as there is some evidence that implicit biases contribute to health disparities, professionals' attitudes toward and interactions with patients, quality of care, diagnoses, and treatment decisions. This may produce differences in help-seeking, diagnoses, and ultimately treatments and interventions. Implicit biases may also unwittingly produce professional behaviors, attitudes, and interactions that reduce patients' trust and comfort with their provider, leading to earlier termination of visits and/or reduced adherence and follow-up. Disadvantaged groups are marginalized in the healthcare system and vulnerable on multiple levels; health professionals' implicit biases can further exacerbate these existing disadvantages.

Interventions or strategies designed to reduce implicit bias may be categorized as change-based or control-based. Change-based interventions focus on reducing or changing cognitive associations underlying implicit biases. These interventions might include challenging stereotypes. Conversely, control-based interventions involve reducing the effects of the implicit bias on the individual's behaviors. These strategies include increasing awareness of biased thoughts and responses. The two types of interventions are not mutually exclusive and may be used synergistically.

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