Management of patients with thyroid disease

Oral health considerations

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ABSTRACT

Background. The thyroid gland and its hormones play an important role in the regulation of growth, development and metabolic functions of the body. Thyroid diseases include a group of conditions that can affect the delivery of dental care.

Literature Reviewed. The authors conducted a MEDLINE search of the medical and dental literature concerning thyroid disease and its management published between 1980 and 2000. The authors found eight published articles concerning this topic in the dental literature; a few of the articles specifically addressed thyroid disease and dental care. They reviewed the medical literature within the scope of provision of dental care.

Conclusions. The oral health care professional can play a role in the screening of dental patients who have undiagnosed thyroid disease. In addition, to treat patients who have thyroid disease, a thorough understanding of the many related pathological conditions, as well as the signs and symptoms that can occur, is needed. Specific dental treatment protocols for these patients are not found in the medicodental literature published between 1980 and 2000.

Clinical Implications. As part of a health care team, the dentist plays an important role in detecting thyroid abnormalities. Modifications of dental care must be considered when treating patients who have thyroid disease.

The incidence of thyroid disease is increasing, predominantly among women.[1] Up to 5 percent of the U.S. female population has alterations in thyroid function,[2-4] and up to 6 percent may have clinically detectable thyroid nodules on palpation.[4] An estimated 15 percent of the general population has abnormalities of thyroid anatomy on physical examination, and an unknown percentage of these do not complete a diagnostic evaluation. It has been suggested that the number of people affected may be twice as many as the undetected cases.[2] This means patients with undiagnosed hypothyroidism or hyperthyroidism are seen in the dental chair, where routine treatment has the potential to result in adverse outcomes.

Dental treatment modifications may be necessary for dental patients who are under medical management and follow-up for a thyroid condition.

In this article, we explore the function and assessment of the thyroid gland and the impact of its dysfunction on the provision of dental care.

PATHOPHYSIOLOGY

The thyroid gland is formed from the pharyngeal epithelium during the third week of fetal development; it then migrates caudally to its final position, which is posterior to the cricoid and arytenoid cartilages in the neck midline. During this process, the thyroglossal duct is formed (in the junction of the anterior two-thirds and posterior one-third of the tongue). The adult gland comprises a bilobular structure, which weighs between 15 and 20 grams, and is connected by a 2-centimeter–wide isthmus that is located anterior to the laryngeal cartilages. The isthmus varies greatly in position and size, making its palpation difficult in certain patients. The gland, however, is palpable in most healthy adults. The internal anatomy of the thyroid gland consists of follicles that contain a mucinous colloid where the protein thyroglobulin is found. Thyroglobulin is the basic building block for the two main hormones produced by the thyroid: triiodothyronine, or T_3, and thyroxine, or T_4. In addition to thyroglobulin, iodine is needed for T_3 and T_4 synthesis.[5]

Iodine is transported into the thyroid

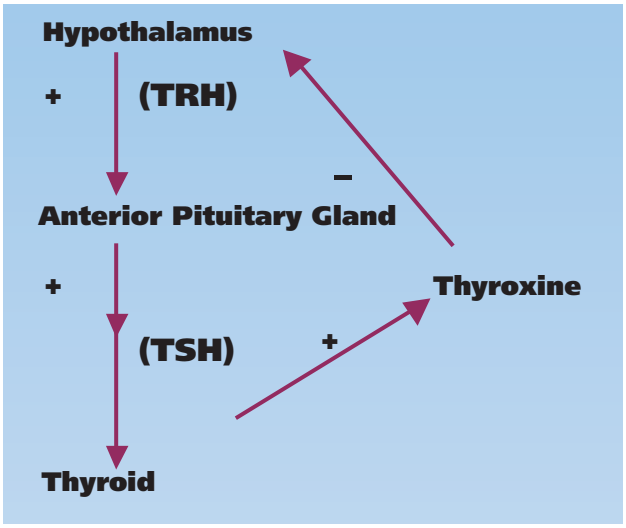

Figure. The hypothalamus releases thyrotropin-releasing hormone, or TRH, which acts on the anterior pituitary gland, releasing thyroid-stimulating hormone, or TSH, or thyrotropin, a glycoprotein that binds to TSH receptors on the thyroid gland. This binding initiates thyroid activity, resulting both in hypertrophy and hyperplasia, as well as the production of thyroid hormones.

follicular cells and is combined with thyroglobulin to form the thyroid hormone precursors monoiodotyrosine and diiodotyrosine. These precursors are transformed into T_3 and T_4 and later released into the bloodstream. T_4 is produced only in the thyroid, while T_3 also can be produced in extraglandular tissues. Once in the plasma, T_4 is bound primarily to T_4-binding globulin, or TBG, and less efficiently to T_4-binding prealbumin (transthyretin) and albumin.[5-9]

Thyroid hormones influence the growth and maturation of tissue, energy metabolism, and turnover of both cells and nutrients. T_4 is at least 25 times more concentrated than T_3 and is deionized in the extraglandular sites to T_3 (about 80 percent of T_3 is produced in this form). Approximately 40 percent of T_4 is deionized to reverse T_3 in a similar manner. Reverse T_3 is not biologically active.

T_3 is the main metabolic effector, with a 10-fold greater affinity over T_4 or nuclear thyroid receptor proteins. The action of this hormone at a molecular level includes the activation of genetic material (mainly transcription and formation of messenger ribonucleic acid) and translation to proteins coding for multiple hormonal and constituent tissues such as growth hormone; thyrotropin-releasing hormone, or TRH; malic enzyme; myosin; and the calcium pump complex of the sarcoplasmic reticulum.[10] Tissue-specific thyroid receptors have been described[11-15] as α and β. α-receptors are found in myocardial cells, and β-receptors are responsible for hormone hemostasis and feedback mechanism. Thyroid function, like many hormonal somatic regulators, is controlled by feedback mechanisms (Figure), in which the thyroid hormones act as direct inhibitors of TRH, thus regulating their own production. A deficiency of either T_4 or T_3 can affect adversely the growth and development of the infant and will decrease metabolic function in the adult. An overproduction or excess availability of thyroid hormones can cause serious and life-threatening complications if not discovered and managed in time.

EVALUATION OF THYROID DISEASE

The American Thyroid Association's Guidelines for Detection of Thyroid Dysfunction[16-19] suggest a screening model for all patients. It is recommended that patients have a serum thyroid-stimulating hormone–, or TSH–, level screen starting at age 35 years and every five years after that, regardless of sex. People from families with history of and risk factors for thyroid disease may be followed more closely. Risk factors include pernicious anemia; diabetes mellitus, or DM; previous surgery or radiation to the head and neck region; vitiligo; family history of thyroid disorders; autoimmune disease; and intake of iodine-containing medications (for example, contrast media for imaging purposes).[16]

The initial screening for thyroid dysfunction is performed as part of a head and neck examination. During a screening, the thyroid gland is examined with the patient's head extended to one side. The examiner uses the fingers of both hands to palpate the thyroid gland. Next, the patient is instructed to swallow, during which time the examiner can evaluate the anatomical extent of the lobules using the last three fingers of one hand. It is important to remember that the right lobule usually is larger than the left and that on relaxation the thyroid outline cannot be observed in a healthy patient. Any anatomical abnormality of the thyroid gland is defined by its consistency, size, tenderness and growth. If an abnormal finding is discovered, hormone and function studies need to follow.

Laboratory studies. Laboratory studies of thyroid function tests are used to confirm a diagnosis of hypo- or hyperthyroidism in symptomatic patients. As thyroid function tests may reflect on

nonthyroid pathology, such as hypothalamic or pituitary disease, the interpretation of these tests needs to be put in perspective (Table).

Due to the negative feedback mechanism regulating thyroid hormone secretion, the measurement of serum TSH is the best test to determine thyroid function.[11,16] Owing, in part, to the sensitivity of TSH assays, the use of the traditional TRH-stimulated test has been revised.

People who have primary hypothyroidism will have increased TSH concentration as a result of the body's attempt to produce more thyroid hormone. Normal values range between 0.7 milli-International Units per milliliter and 5.3 mIU/mL for adults. Low or undetectable TSH levels generally suggest hyperthyroidism. Normal TSH levels in the presence of abnormal T_3 or T_4 concentrations indicate a nonthyroid pathology.

The total concentration of T_4 is determined by the ratio of T_4 secreted by the thyroid, the amount of T_4 cleared and the serum concentration of TBG. Patients with hyperthyroidism have increased levels of T_4 or decreased TBG. Low serum concentration of T_4 and increased TBG indicate a hypothyroid state. To assess the serum concentration of free T_4, or FT_4, an assay is performed that determines the rate of T_4 binding to serum proteins. Range values for FT_4 are 60 to 150 nanomoles per liter, and 0 to 3 nmol/L for free T_3, or FT_3. The thyroid hormone binding ratio, also known as the T_3 resin uptake test, measures the unoccupied binding sites for T_4. The direct testing of thyroid function involves in vivo administration of radioactive iodine, usually iodine 123. The thyroid radioactive iodine uptake is the most common direct assay; the range for normal is wide, between 10 and 30 percent uptake of the administered dose.

The TRH stimulation test is useful in confirming states of thyrotoxicosis, as it tests the response to elevated TRH. Other available tests include the detection of antibodies against T_3 or T_4 in cases in which the thyroid pathology is of autoimmune etiology. A diagnosis of hyperthyroidism is confirmed by obtaining a TSH level less than 0.1 mIU/mL. In both primary and secondary hyperthyroidism, FT_4 levels are elevated.

Several imaging techniques are useful for evaluating an apparent abnormal thyroid gland. Magnetic resonance imaging and sonography can detect the presence and extent of tumors or masses. Fine-needle biopsy can be useful when malignancy is suspected or to rule out cystic pathology.

TABLE 1

THYROID FUNCTION SCREENING TESTS.

PRESUMPTIVE DIAGNOSIS	THYROID-STIMULATING HORMONE	FREE THYROXINE*
Primary Hyperthyroidism	-†	+‡
Secondary Hyperthyroidism (Pituitary/Other)	+/N§	+
Primary Hypothyroidism	+	-
Secondary Hypothyroidism (Pituitary/Other)	-/N	-
Subclinical Hypothyroidism	+	N
Subclinical Hyperthyroidism	-	N
Euthyroid State	N	N

* Free thyroxine, or FT_4, determines thyroid function and presumptive diagnosis of hypothyroidism or hyperthyroidism. It is correlated with other thyroid function tests to confirm diagnosis levels of FT_4.
† -: Decreased hormone levels.
‡ +: Increased hormone levels.
§ N: Normal hormone levels.

HYPOTHYROIDISM

Hypothyroidism is defined by a decrease in thyroid hormone production and thyroid gland function. It is caused by severe iron deficiency, chronic thyroiditis (Hashimoto's disease), lack of stimulation, radioactive iodine that causes follicle destruction, surgery and pharmacological agents such as lithium and amiodarone, the latter of which is a commonly used antidysrhythmic.[20-24] This condition can be classified into two categories: primary hypothyroidism, in which the defect is intrathyroid; or secondary hypothyroidism, in which other pathologies can cause an indirect decrease of circulating hormone (for example, surgical or pathological alteration of the hypothalamus).

Congenital hypothyroidism refers to alteration in formation of the thyroid gland. It can be caused

by dysgenesis, agenesia, inborn defect in hormone production or secretion. Defects in pituitary or hypothalamic metabolism account for some cases.

Acquired hypothyroidism includes idiopathic hypothyroidism, in which no physiological, autoimmune or biochemical abnormality is found, and it is secondary to hypothalamic or pituitary neoplasms or surgery. Iatrogenic hypothyroidism can be caused by surgery or radiation therapy to the gland. Endemic hypothyroidism is found in specific populations or geographic areas and is related to a high–iodine-content diet.

Hashimoto's disease is an autoimmune thyroiditis, in which there is a lymphocytic infiltrate into the gland and the production of autoantibodies directed toward thyroglobulin and thyroid peroxidase. Consequently, both the building unit and the enzyme in charge of production of the thyroid hormones are blocked. A firm enlargement of the gland (known as goiter) with antithyroid antibodies is pathognomonic. Between 20 and 50 percent of women with Hashimoto's disease present initially with goiter.

Tissue resistance to thyroid hormones is associated with elevated levels of FT_3 and FT_4, and high normal or elevated TSH. There is a normal TSH response to TRH stimulation. Tissue resistance is believed to be caused by mutations of the thyroid hormone β-receptors.

If hypothyroidism is present in infancy, it is manifested as cretinism. Characteristic signs of cretinism include developmental delay, frontal bossing, short stature, protruding tongue, hypertelorism, dry skin and alopecia. In adults, hypothyroidism is manifested as myxedema and is characterized by widespread metabolic slowdown, depression, overweight, generalized edema, diminished cardiac output, decreased pulse and respiratory rate, paresthesia, status epilepticus, skin dryness, scalp brittleness, nonpitting skin edema, periorbital edema, hoarseness and sinus bradycardia[24-26] (Box 1).

Medical conditions associated with hypothyroidism include hypercholesterolemia, hyponatremia and anemia. Mild or subclinical hypothyroidism[27,28] refers to elevations of TSH in association with normal levels of FT_4. Subclinical hypothyroidism has been linked with high cholesterol levels, atrial fibrillation and osteoporosis in females. Recently, subclinical hypothyroidism has been considered to be an important risk factor for coronary heart disease in women. Cardiac-specific findings are sinus bradycardia, pericardial effusion, heart failure and coronary atheromas.[29-34]

Abnormal laboratory values associated with hypothyroidism include increased low-density lipoproteins, or LDL; serum cholesterol; creatine; aspartate aminotransferase; serum lactate dehydrogenase; and pernicious anemia. TSH levels are elevated in primary hypothyroidism, decreased in secondary hypothyroidism and elevated in subclinical hypothyroidism. TSH levels greater than 2 IU/mL are indicative of hypothyroidism. FT_4 is decreased but can be normal in subclinical states. Interestingly, gastric antiparietal antibodies have been found in some people, which explains the observed achlorhydria in these patients who have hypothyroidism. This raises questions about the possible autoimmune etiology for the condition.

Medical management. Comprehensive treatment for thyroid disorders is beyond the scope of this review. In general, for hypothyroidism, levothyroxine sodium, or l-thyroxine, replacement is the first drug of choice and is implemented at 0.25 milligrams every day and titrated according to the patient's response at monthly intervals. The appropriate initiating dose should be around 1.6 micrograms per kilogram. An extra dose may be required during pregnancy or when taken concurrently with intake of rifampin and some anticonvulsant medications.[35] Careful monitoring by the physician is required because of the possibility of causing iatrogenic hyperthyroidism with uncontrolled therapy. The hormone T_3 can be used in case of T_3 deficiency, and there is the option of combining both T_4 and T_3 when severe deficiency of both hormones is present. As mentioned previously, l-thyroxine continues to be the preferred agent because of the undesired effects of T_3 and the combined presentation in the older population (mainly with cardiac complications). People who have angina pectoris (symptomatic ischemic heart disease) should take l-thyroxine in the morning; at least 30 minutes or more before breakfast; and at least one hour before or after taking iron supplements, antacids or sucralfate.[19] Hormone dose is increased 0.25 mg every three weeks until a 1 mg/day dosage is reached. Thyroid function tests are performed at six weeks after treatment is initiated. Effectiveness of therapy is measured by a sensitive TSH assay, in which an elevated value indicates insufficient treatment. Hormone levels may need to be titrated in cases of immune-mediated hypothyroidism and in relation to interactions with certain medications.

Once the euthyroid state is achieved, the patient's TSH and FT_4 levels are followed for periods of six months to one year. In infantile or neonatal states, therapy should start as soon as possible owing to the risk of developmental delay. In cases of pituitary or hypothalamic hypothyroidism, however, corticosteroid treatment should precede thyroid hormone therapy to avoid the possibility of adrenal insufficiency.

A complication of myxedema is the myxedematous coma, manifested as hypothermia, bradycardia and severe hypotension. Persistent myxedema can lead to cardiomegaly.[36] Another complication of the hypothyroid state is the syndrome of inappropriate adrenal stimulating hormone secretion, defined as persistent hyponatremia and serum hypo-osmolality. If not treated, it can cause serious neurological sequelae.

BOX 1

CHARACTERISTICS OF THYROID DISEASE.

HYPOTHYROIDISM	HYPERTHYROIDISM
Anemia	Abdominal pain
Cardiomegaly	Cardiac murmur
Cold intolerance	Diplopia
Constipation	Dysrhythmias
Cretinism (children)	Elevated alkaline phosphatase, aspartate transaminase and alanine transaminase levels
Dry hair	Fatigue
Elevated aspartate transaminase, alanine transaminase and lactate dehydrogenase levels	Fine hair
Elevated creatine	Goiter
Goiter	Heat intolerance
Hyperlipidemia	Hypercalcemia
Hypertelorism	Increased appetite
Hypotension	Increased cardiac output
Inverted T waves in electrocardiogram	Increased pulse
Lethargy	Nervousness
Low-amplitude QRS wave in electrocardiogram	Palpitations
Myxedema	Proptosis
Paresthesia	Psychosis
Reduced cardiac output	Tachycardia
Reduced respiratory rate	Tremor
Seizures	Warm skin
Tachycardia	Weight loss
Weight gain	

HYPERTHYROIDISM

Hyperthyroidism is a condition caused by unregulated production of thyroid hormones. Thyrotoxicosis is a serious sequela of hyperthyroidism that corresponds to an overt tissue exposure to excess circulating thyroid hormones. It is characterized by tremor, emotional instability, intolerance to heat, sinus tachycardia, marked chronotropic and ionotropic effects, increased cardiac output (increased susceptibility to congestive heart failure), systolic heart murmur, hypertension, increased appetite and weight loss.[10,37,38] It can be caused by thyroid hyperfunction, metabolic imbalance or extraglandular hormone production.

Graves' disease is a pathological complex produced by hyperthyroidism with diffuse goiter, ophthalmopathy and dermopathy. Not all of these signs necessarily appear together during the course of the disease. Graves' disease can occur at any age, but it is discovered mostly in the third and fourth decades of life. It is four to seven times more prevalent in women than in men.[39,40] There also is an important genetic component to Graves' disease with increased human leukocyte antigen haplotypes B8 and DRw3 among Caucasians, Bw36 among Japanese and Bw46 among Chinese.[1] Antibodies also have been detected against the TSH receptor.

It is not always necessary to be able to palpate the thyroid gland in the presence of clinical signs and symptoms of hyperthyroidism. This can be explained by the presence of extrathyroid glandular tissue that cannot be palpated on examination.

People who have excessive thyroid-circulating hormones may develop cardiac abnormalities as a result of the overt overstimulation of myocardial metabolism, leading to arrhythmias and atrial fibrillation. This is rare in patients younger than 40 years of age unless there is a presence of long-standing thyrotoxicosis. Of note is that hyperthyroid-induced atrial fibrillation can be resistant to digitalis. Other findings on examination include forceful point of maximal impulse and flow murmurs. Additional physical manifestations associated with thyrotoxicosis include oncholysis, fine tremor of fingers and hands, ocular signs such as widened palpebral fissuring, proptosis and infrequent blinking, and weight loss is evident. The condition is characterized by cyclic phases of remission with no predictability.

There is evidence that certain people who have hyperthyroidism can be susceptible to developing asthma and that euthyroid states positively influence asthmatic control. Underlying mechanisms that could explain this relationship include increased sensitivity to catecholamines, superoxide production and increase production of bronchoconstrictive prostaglandins (known as PGE and PGF) in hyperthyroidism.[41]

Other thyroid conditions. Thyroid nodules represent growth of the thyroid gland with corresponding elevation of hormone synthesis. Toxic goiter (uni- or multinodular) is a disease found mostly among elderly people, arising from longstanding simple goiter, with formation of autonomous nodules. Other conditions involving the thyroid gland include pyogenic thyroiditis, Riedel's thyroiditis, subacute granulomatous thyroiditis and several neoplasms such as adenomas.

Medical management. Treatment for hyperthyroidism includes administration of propylthiouracil (300-600 mg/day total at eight-hour intervals) or methimazole (30-60 mg/day total, administered in two doses), which are thioamides that inhibit hormone biosynthesis by aborting the iodotyrosine residue coupling. Starting dose for the propylthiouracil is 100 mg every six to eight hours. Methimazole is more effective than propylthiouracil but with more side effects. The main purpose of this therapy is to limit the circulating hormone. Surgery and radiotherapy (iodine 131, or I-131) are other options, but they are associated with the risk of creating permanent hypothyroidism. Radioactive iodine therapy is used for patients who have Graves' disease, as well as severe cardiac compromise, toxic uni- or multinodular goiter or severe reaction to antithyroid drugs. Contraindications for radiotherapy are pregnancy, breast-feeding or acute ophthalmopathy. Methimazole should precede iodine treatment in patients who have severe hyperthyroidism or a large goiter to stop exacerbation of the hyperthyroid state secondary to radiation.[41] The prevalence of hypothyroidism induced by I-131 is between 2 and 3 percent of patients treated with this modality.[26,41] If hypothyroidism persists for more than six months after therapy, hormone replacement must be implemented. The use of I-131 therapy in children, however, is controversial and has been linked with glandular oncogenesis. Glucocorticosteroids, such as dexamethasone, can be used in cases of severe thyrotoxicosis. Adrenergic antagonists such as propanolol are used to control the symptoms associated with thyrotoxicosis such as sweating, tremor, anxiety and tachycardia. Subtotal thyroidectomy (partial removal of the thyroid gland) is being used less owing to the efficacy of iodine treatment, but it persists as an option in young patients who are resistant to pharmacological treatment and in some people who have thyroid neoplasms.

During pregnancy, pharmacological management should consist of the lowest dose that can maintain the euthyroid state. Propylthiouracil has been preferred over methimazole, presumably because the former did not cross the placenta, but research has found evidence to the contrary.[42]

"Thyroid storm" is the main complication of persistent hyperthyroidism. It is defined as the body's response to maintained thyrotoxicosis. Thyroid storm commonly is expressed as extreme irritability and delirium, a temperature of higher than 41 C, tachycardia, hypotension, vomiting and diarrhea. Thyroid storm is the body's response to maintained thyrotoxicosis. This is common in postoperative states in patients who have uncontrolled or undiagnosed hyperthyroidism. It also can be triggered by a surgical emergency, sepsis and trauma. Some case reports describe acute renal failure, lactic acidosis and absence of fever.[43] The initiating stimulus for thyroid storm is unknown. It has been hypothesized that it is not caused by glandular hyperfunction but rather by a decrease in protein binding capacity. Severe cardiac dysrhythmias and blockages can occur secondary to long-term exposure to thyroid hormones.

DENTAL MANAGEMENT OF PATIENTS WHO HAVE THYROID DISEASE

Controlling thyroid disease is defined by length of treatment, medical follow-up, thyroid hormone levels and absence of symptoms. Patients who have euthyroidism routinely are followed up at least twice a year. In patients affected by hypothyroidism, history of levothyroxine sodium dosage can be used to assess control.

Following are recommendations for dental care for patients who have a known thyroid disease and are on medications. The oral health care professional should be familiar with the oral and systemic manifestations of thyroid disease so he or she can identify any complication and assess the level to which the condition is controlled. If a suspicion of thyroid disease arises for an undiagnosed patient, all elective dental treatment

should be put on hold until a complete medical evaluation is performed.

Hypothyroidism. Common oral findings in hypothyroidism include macroglossia, dysgeusia, delayed eruption, poor periodontal health and delayed wound healing.[44] Before treating a patient who has a history of thyroid disease, the dentist should obtain the correct diagnosis and etiology for the thyroid disorder, as well as past medical complications and medical therapy. Further inquiry regarding past dental treatment is justified. The condition's prognosis usually is given by the time of treatment and patient compliance.

In patients who have hypothyroidism, there is no heightened susceptibility to infection. They are susceptible to cardiovascular disease from arteriosclerosis and elevated LDL. Before treating such patients, consult with their primary care providers who can provide information on their cardiovascular statuses. Patients who have atrial fibrillation can be on anticoagulation therapy and might require antibiotic prophylaxis before invasive procedures, depending on the severity of the arrythmia.[45] If valvular pathology is present, the need for antibiotic prophylaxis must be assessed. Drug interactions of l-thyroxine include increased metabolism due to phenytoin, rifampin and carbamazepine, as well as impaired absorption with iron sulfate, sucralfate and aluminum hydroxide. When l-thyroxine is used, it increases the effects of warfarin sodium and, because of its gluconeogenic effects, the use of oral hypoglycemic agents must be increased. Concomitant use of tricyclic antidepressants elevates l-thyroxine levels. Appropriate coagulation tests should be available when the patient is taking an oral anticoagulant and thyroid hormone replacement therapy. Patients who have hypothyroidism are sensitive to central nervous system depressants and barbiturates, so these medications should be used sparingly.[12,44]

During treatment of diagnosed and medicated patients who have hypothyroidism, attention should focus on lethargy, which can indicate an uncontrolled state and become a risk for patients (for example, aspiration of dental materials), and respiratory rate. It is important to emphasize the possibility of an iatrogenic hyperthyroid state caused by hormone replacement therapy used to treat hypothyroidism. Hashimoto's disease has been reported to be associated with DM,[1,21] and patients who have DM might become hyperglycemic when treated with T_4. When providing dental care to patients who have DM, attention should focus on complications associated with poor glycemic control, which may cause decreased healing and heightened susceptibility to infections.[39,44]

In a literature review, Johnson and colleagues[15] examined the effects of epinephrine in patients who have hypothyroidism. No significant interaction was observed in controlled patients who had minimal cardiovascular involvement. In patients who have cardiovascular disease (for example, congestive heart failure and atrial fibrillation) or who have uncertain control, local anesthetic and retraction cord with epinephrine should be used cautiously. People who are on a stable dosage of hormone replacement for a long time should have no problem withstanding routine and emergent dental treatment. Hemostasis is not a concern unless the patient's cardiovascular status mandates anticoagulation.

For postoperative pain control, narcotic use should be limited, owing to the heightened susceptibility to these agents.

Hyperthyroidism. Before treating a patient who has hyperthyroidism, the oral health care professional needs to be familiar with the oral manifestations of thyrotoxicosis, including increased susceptibility to caries, periodontal disease, enlargement of extraglandular thyroid tissue (mainly in the lateral posterior tongue), maxillary or mandibular osteoporosis, accelerated dental eruption[46] and burning mouth syndrome (Box 2). In patients older than 70 years of age, hyperthyroidism presents as anorexia and wasting, atrial fibrillation and congestive heart failure. In young patients, the main manifestation of hyperthyroidism is Graves' disease, while middle-aged men and women present most commonly with toxic nodular goiter. Development of connective-tissue diseases like Sjögren's syndrome and systemic lupus erythematosus also should be considered when evaluating a patient who has a history of Graves' disease.

Taking a careful history and conducting a thorough physical examination can indicate to the oral health care professional the level of thyroid hormone control of the patient. Patients who have hyperthyroidism are susceptible to cardiovascular disease from the ionotropic and chronotropic effect of the hormone, which can lead to atrial dysrhythmias.[31,32,45,46] It is important that the dentist address the cardiac history of these patients.

BOX 2

ORAL MANIFESTATIONS OF THYROID DISEASE.

HYPERTHYROIDISM

- Increased susceptibility to caries
- Periodontal disease
- Presence of extraglandular thyroid tissue (struma ovarii—mainly in lateral posterior tongue)
- Accelerated dental eruption
- Burning mouth syndrome

HYPOTHYROIDISM

- Salivary gland enlargement
- Macroglossia
- Glossitis
- Delayed dental eruption
- Compromised periodontal health—delayed bone resorption
- Dysgeusia

BOX 3

CONSIDERATIONS FOR DENTAL TREATMENT.

BEFORE TREATMENT: ASSESSMENT OF THYROID FUNCTION

- Establish type of thyroid condition.
- Is there a presence of cardiovascular disease? If yes, assess cardiovascular status.
- Are there symptoms of thyroid disease? If yes, defer elective treatment and consult a physician.
- Obtain baseline thyroid-stimulating hormone, or TSH. Control is indicated by hormone levels, length of therapy and medical monitoring. If the patient has received no medical supervision for more than one year, consult a physician.
- Obtain baseline complete blood count. Give attention to drug-induced leukopenia and anemia.
- Assess medication and interactions with thyroxine and TSH. Make proper treatment modifications if the patient is receiving anticoagulation therapy.
- Take blood pressure and heart rate. If blood pressure is elevated in three different readings or there are signs of tachycardia/bradycardia, defer elective treatment and consult a physician.

DURING TREATMENT

- Oral examination should include salivary glands. Give attention to oral manifestations.
- Monitor vital signs during procedure:
  - Is the patient euthyroid? If yes, there is no contraindication to local anesthetic with epinephrine.
  - Use caution with epinephrine if the patient taking nonselective β-blockers.
  - If the patient's hyperthyroidism is not controlled, avoid epinephrine; only emergent procedures should be performed.
- Minimize stress—appointments should be brief.
- Discontinue treatment if there are symptoms of thyroid disease.
- Make pertinent modifications if end-organ disease is present (diabetes, cardiovascular disease, asthma).

AFTER TREATMENT

- Patients who have hypothyroidism are sensitive to central nervous system depressants and barbiturates.
- Control pain.
- Use precaution with nonsteroidal anti-inflammatory drugs for patients who have hyperthyroidism, avoid aspirin.
- Continue hormone replacement therapy or antithyroid drugs as prescribed.

Consulting the patients' physicians before performing any invasive procedures is indicated in patients who have poorly controlled hyperthyroidism. Treatment should be deferred if the patients present with symptoms of uncontrolled disease. These symptoms include tachycardia, irregular pulse, sweating, hypertension, tremor, unreliable or vague history of thyroid disease and management, or neglect to follow physician-initiated control for more than six months to one year.

A decrease in circulating neutrophils has been reported during thyroid storm crisis. Dental treatment, however, usually is not a priority in this state. Susceptibility to infection can increase from drug side effects. People who have hyperthyroidism and are treated with propylthiouracil must be monitored for possible agranulocytosis or leukopenia as a side effect of therapy. Besides its leukopenic effects, propylthiouracil can cause sialolith formation and increase the anticoagulant effects of warfarin. A complete blood count with a differential will indicate if any medication-induced leukopenia may be present. Aspirin; oral contraceptives; estrogen; and nonsteroidal anti-inflammatory drugs, or NSAIDs, may decrease the binding of T_4 to TBG in plasma. This increases the amount of circulating T_4 and can lead to thyrotoxicosis. Aspirin, glucocorticosteroids, dopamine and heparin can decrease levels of TSH, complicating a correct diagnosis of primary or pituitary hyperthyroidism.

The use of epinephrine and other sympathomimetics warrants special consideration when treating patients who have hyperthyroidism and are taking nonselective β-blockers.[37] Epinephrine acts on α-adrenergic receptors causing vasoconstriction and on β_2 receptors causing vasodilation. Nonselective β-blockers eliminate the vasodilatory effect,

potentiating an α-adrenergic increase in blood pressure. This mechanism applies to any patient who is taking nonselective β-blockers, and it is relevant in patients who have hyperthyroidism because of the possible cardiovascular complications that can arise. Knowledge of the described interactions should alert the clinician for any possible complication.

During treatment, heightened awareness toward oral soft- and hard-tissue manifestations, as described previously, should be emphasized.[47] Oral examination should include inspection and palpation of salivary glands. If the patient does not have any cardiovascular disease or is not receiving anticoagulation therapy, hemostatic considerations should not represent a concern for invasive oral procedures. Management of the patient receiving anticoagulation therapy has been described in the literature.[48]

Oral health care professionals should recognize the signs and symptoms of a thyroid storm, as the patient could present for dental care during its initial phase or when undiagnosed. Patients who have hyperthyroidism have increased levels of anxiety, and stress or surgery can trigger a thyrotoxic crisis. Epinephrine is contraindicated, and elective dental care should be deferred for patients who have hyperthyroidism and exhibit signs or symptoms of thyrotoxicosis. Brief appointments and stress management are important for patients who have hyperthyroidism. Treatment should be discontinued if signs or symptoms of a thyrotoxic crisis develop and access to emergency medical services should be available.

After treatment, proper postoperative analgesia is indicated. NSAIDs should be used with caution in the patients who have hyperthyroidism and who take β-blockers, as the former can decrease the efficiency of the latter. Pain, however, can complicate cardiac function in patients who have hyperthyroidism and symptomatic disease, and alternative pain medications need to be instituted. It is important that patients continue taking their thyroid medication as prescribed. If an emergent procedure is needed in the initial weeks of thyroid treatment, close work-up with the endocrinologist is needed (Box 3).

CONCLUSIONS

Patients who have thyroid disease present a treatment challenge to dentists. Awareness of the condition and current stage of treatment is important in understanding the possible modifications needed for dental treatment. Length and current state of therapy are important in understanding the metabolic control of patients. The main complications of both patients with hyperthyroidism and hypothyroidism are associated with cardiac comorbidity. Other comorbid conditions are DM and asthma. Consultation with the patient's primary care physician or an endocrinologist is warranted if any sign or symptom of thyroid disease is noted on examination.

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Dental treatment modifications may be necessary for dental patients who are under medical management and follow-up for a thyroid condition even if there are no comorbid conditions. Stress reduction, awareness of drug side effects or interactions, and vigilance for appearance of signs or symptoms of hormone toxicity are among the responsibilities of the oral health care provider. ■

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