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Review

Thyroid Dysfunction: Risk and Management in Dentistry

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Abstract: The thyroid gland secretes essential hormones for the growth regulation and the metabolic activity of the body. Thyroid dysfunction includes many conditions that can indirectly affect dental treatments. Therefore, the practitioner must be aware of these pathologies and their signs and symptoms in order to elaborate specific dental treatment plans, thus avoiding any per-and/or postoperative complications. Moreover, the dentist can help in the screening of undiagnosed thyroid dysfunction among patients.

Keywords: Dentistry, Hyperthyroidism, Hypothyroidism, Management, Oral Manifestations, Thyroid Gland

Introduction

The thyroid is an endocrine gland located on the anterior midline of the neck below the inferior part of the larynx at the superior segment of the trachea. It consists of two oval shaped lobes connected by an isthmus. The mean lobe dimensions and weight are 5×2.5×2.5 cm and 25 mg, respectively (Khan *et al.*, 2020). Microscopically, the thyroid gland is composed of spherical follicles bordered by follicular cells and containing a substance called colloid which is thyroglobulin. This thyroglobulin along with the circulating iodine form monoiodotyrosine and diiodotyrosine, precursors of the thyroid hormones, tetraiodothyronine known as Thyroxine (T4) and Triiodothyronine (T3) (Khan *et al.*, 2020).

Between the thyroid follicles or inside their wall are located multiple small cells, the C-cells (parafollicular cells), responsible for another thyroid hormone known as calcitonin (Khan *et al.*, 2020).

The secretion of thyroid hormones, mainly T3 and T4, is directly under the control of the hypothalamus via the TSH releasing hormone-TRH and the pituitary gland via the thyroid stimulating hormone-TSH. This is done through a negative feedback mechanism (Ortiga-Carvalho *et al.*, 2011).

As for calcitonin secretion, it is mostly stimulated by the increase of serum calcium concentration (Felsenfeld and Levine, 2015).

The thyroid hormones are essential for the metabolic activity of all the body; they are essential to the normal functioning of most of the organs. Some of these functions are summarized in Table 1.

Table 1: Some of the thyroid functions (Khan *et al.*, 2020)

They assist in the growth, development and differentiation of all the body cells (Hofstee *et al.*, 2019; Talat *et al.*, 2019).
They are a key regulator of the Basal Metabolic Rate (BMR) which is one of the major components of energy expenditure. In humans, BMR decrease can lead to obesity (Khan *et al.*, 2020; Taousani *et al.*, 2017).
They play an important role in calcium homeostasis (calcitonin, which is stimulated by hypercalcemia, fights against it) (Khan *et al.*, 2020; Felsenfeld and Levine, 2015) and bone mineral homeostasis and density (deposition of calcium and phosphate in the bones) (Khan *et al.*, 2020).
They are vital for the development of central nervous system in children and brain maturation and function for life (Khan *et al.*, 2020; Zhu *et al.*, 2018; Bernal, 2000).
They stimulate somatic and psychic growth (Khan *et al.*, 2020) and have major influence on the mood and behavior (mental and behavioral disorders may occur with thyroid hormones imbalance) (Acar and Ulgen, 2020).
They play an important role in the normal function of the heart (rate and contraction) and vascular physiology (Delitala *et al*., 2019; Udovcic *et al.*, 2017).
They contribute to the control carbohydrate, fat, protein and vitamins metabolism (Damiano *et al.*, 2017).
They aid in regulating the body temperature (increased level of thyroid hormones rises body temperature and the opposite is true) (Khan *et al.*, 2020).
They play a vital role in maintaining electrolyte balance (Khan *et al.*, 2020).
They influence the oxygen consumption by the cells and tissues (McAninch *et al.*, 2015).
They stimulate gastrointestinal motility (Lee *et al.*, 2012).
They improve the sensitivity of the β-adrenergic receptors to catecholamines (Khan *et al.*, 2020).
They improve mitochondrial metabolism (Khan *et al.*, 2020).
They serve a main role in regulating erythropoiesis (Park *et al.*, 2017).

Thyroid Dysfunction

Thyroid dysfunction is quite common in the general population, especially among women; moreover, it has been suggested that the number of undetected cases of thyroid dysfunction may be twice compared to the detected ones (Gessl *et al.*, 2013). Typically, thyroid dysfunction is divided into hyperthyroidism and hypothyroidism.

Hypothyroidism

Hypothyroidism is a decrease in thyroid gland function and thyroid hormone secretion. It is classified into 3 categories: (a) Primary (autoimmune, iatrogenic, transient and iodine deficiency), (b) secondary (pituitary failure and tumor) and (c) tertiary (hypothalamic failure) (Jefferys *et al.*, 2015).

In the United States, Hashimoto's thyroiditis (autoimmune disease) is the most frequent cause of hypothyroidism, but, globally, nutritional iodine deficiency is the most common cause (Patil *et al.*, 2020). Some of hypothyroidism causes are summarized in Table 2.

It should be noted that subacute and postpartum thyroiditis are transient types; in fact, patients with subacute thyroiditis (de Quervain thyroiditis, other) go through different phases over a period of weeks to months. Initially, they present as hyperthyroid, followed by a hypothyroid phase before eventually returning to being euthyroid (Tabassom and Edens, 2020). As for postpartum thyroiditis, the clinical course of the disease is variable and may include hyperthyroidism or hypothyroidism with spontaneous resolution in 32 and 43% of cases, respectively, or hyperthyroidism followed by hypothyroidism with spontaneous resolution (25%) (Stagnaro-Green, 2002). Approximately 30% of women affected will stay hypothyroid one year postpartum (Keely, 2011).

Clinically, the signs and symptoms can be mild and nonspecific and differs from one patient to another (Patil *et al.*, 2020). When severe hypothyroidism occurs in childhood, it is referred to as cretinism; the major cause of cretinism is chronic iodine deficiency and it is, usually, presented as following: (a) Short stature/poor growth, (b) decreased activity, (b) frontal bossing, (c) tongue protrusion, (d) hoarse voice, (e) hypertelorism, (f) muscles weakness (hypotonia), (g) dry skin and (h) alopecia (Pinto and Glick, 2002).

In adults, typical features of hypothyroidism include enlarged gland, weight gain, depression, anxiety, psychosis, memory loss, dysarthria and voice changes, bradykinesia, lethargy, dry skin and hair, pallor and jaundice, blank facial expressions, macroglossia, bradycardia, constipation, asthenia and muscle cramps, cold intolerance, sleep disorders, menstrual cycle irregularities, galactorrhea (Patil *et al.*, 2020; Garber *et al.*, 2012). Patient can also present sleep apnea, hyponatremia, hypercholesterolemia, congestive heart failure, pericardial effusion and prolonged QT interval (Garber *et al.*, 2012).

It is important to note that myxedema coma, an exceptional lethal condition, is a result of severely advanced hypothyroidism with loss of the adaptive mechanism to maintain homeostasis (Elshimy and Correa, 2020).

Diagnosis of hypothyroidism is based on signs and symptoms, a low serum level of T4 and a high serum TSH level (Garber *et al.*, 2012).

Hypothyroidism is primarily treated with levothyroxine monotherapy (Jonklaas *et al.*, 2014). Therapy should be monitored based on TSH serum levels which must be tested every 4 to 8 weeks until target is achieved; when stable, then the monitoring interval can be extended to 6 to 12 months (Garber *et al.*, 2012).

Hyperthyroidism

Hyperthyroidism is a syndrome related to thyroid hormone production excess. Graves's disease and toxic multinodular goiter are the more frequent causes of hyperthyroidism; however, other etiologies may include: Toxic adenomas, subacute thyroiditis and iodine-induced hyperthyroidism (Jod-Basedow phenomenon) (Jefferys *et al.*, 2015; Mathew and Rawla, 2020) Table 3.

Table 2: Main causes of hypothyroidism (Jefferys *et al.*, 2015)

Causes of hypothyroidism
- **Primary:**
• Autoimmune disease:
• Atrophic thyroiditis
- Hashimoto's thyroiditis (Patil *et al.*, 2020)
- Iatrogenic:
• Radioactive iodine therapy (Husseni, 2016)
• Thyroidectomy
• Drugs (anti-thyroid, amiodarone, thalidomide, lithium…) (Taylor *et al.*, 2018)
- Transient:
• Subacute thyroiditis
• Postpartum thyroiditis (Patil *et al.*, 2020)
- Iodine deficiency (Patil *et al.*, 2020)
Secondary hypothyroidism:
- Pituitary failure
- Pituitary tumor
Tertiary hypothyroidism:
- Hypothalamic failure

Table 3: Main causes of hyperthyroidism (Jefferys *et al*., 2015)

Causes of hyperthyroidism
-Autoimmune
• Grave's disease
-Toxic nodular goiter
-Toxic adenoma
-Subacute thyroiditis
-Iodine-induced hyperthyroidism
-Drug-induced (amiodarone, lithium)

Hyperthyroidism pathophysiology depends on the etiology of the condition; in Grave's disease, the original cause is autoimmune where thyroid-stimulating immunoglobulins are produced and went to bind to the TSH receptor, thus mimicking the TSH effects. On the other hand, the toxic multinodular goiter which presents with palpable thyroid nodules lead to the production of excess thyroid hormone from autonomous ectopic tissue (Mathew and Rawla, 2020).

Unlike the toxic multinodular goiter which can be formed by multiple nodules, toxic adenoma classically presents with a solitary papillary nodule that also causes hyperthyroidism (Mathew and Rawla, 2020).

Clinically, hyperthyroidism signs and symptoms reflect the state of increased metabolic activity including weight loss despite an augmented appetite, heart palpitation, anxiety, tremors, weakness, diarrhea, heat intolerance, atrial fibrillation, congestive heart failure and shortness of breath (Mathew and Rawla, 2020).

Physical examination may reveal an enlarged gland in the case of goiter or one or more palpable nodules (De Leo *et al.*, 2016).

Diagnosis of hyperthyroidism is based on TSH, T4 and T3 serum levels tests. Due to the negative feedback that T3 and T4 apply on the pituitary gland, elevated T3 and/or elevated T4 will cause decreased TSH production (Menconi *et al.*, 2014).

Treatment of hyperthyroidism depends on the underlying cause. Usually 2 types of treatment are considered, symptomatic and basic. In the former, the physician prescribes drugs depending on the symptoms; e.g., beta-adrenergic antagonist or calcium channel blocker to control the palpitations, anxiety and tremor (Ross *et al.*, 2016). As for the basic treatment, radioactive iodine therapy, thionamide therapy and subtotal thyroidectomy can be used. It is important to note that all of them predispose the patient to possible long-term hypothyroidism. Thus, clinical assessment and T4 monitoring are crucial for patients who undergo any of these treatments (Mathew and Rawla, 2020).

It is important to note that untreated hyperthyroidism can lead to a major, potentially life-threatening complication referred to as thyroid storm (thyrotoxic crisis). In this condition reflecting the advanced state of hyperthyroidism and requiring immediate attention, the patient suffers from tachycardia, increased gastrointestinal motility, diaphoresis, anxiety and fever (Mathew and Rawla, 2020).

Dental Management of Patients with Thyroid Dysfunction

In dentistry, the risk in treating patients with controlled thyroid dysfunction is not elevated. Contrariwise, undiagnosed or uncontrolled thyroid conditions are risky (Malamed, 2015). For that, the dentist should be alert for any warning signs of such dysfunction and then refer the patient for medical consultation before any dental treatment.

Following are common oral manifestations found in thyroid disorders as well as the precautions dental practitioners should take to avoid potential complications during or after dental treatments.

Hypothyroidism

Frequent oral findings in hypothyroidism include macroglossia, glossitis, dysgeusia, compromised periodontal health, salivary gland enlargement and delayed dental eruption and wound healing (Table 4) (Pinto and Glick, 2002; Young, 1989).

Before treating patients with hypothyroidism, a specialized consultation is mandatory for more information on their medical conditions (e.g., cardiovascular status, lethargy, etc.) and the treatment will be provided accordingly. Well-controlled patients require no special precautions while in uncontrolled patients elective treatments should be deferred (Patton, 2015).

Moreover, dentists should be aware that patients under levothyroxine may experience an increased response to drugs affecting the central nervous system function such as narcotics, tranquillizers and barbiturates. Their use should be avoided (Pinto and Glick, 2002; Patton, 2015).

Hyperthyroidism

Oral manifestations in hyperthyroidism may include increased susceptibility to caries, severe periodontal disease, extra glandular thyroid tissue enlargement (mostly in the posterior dorsum of the tongue, known as ectopic or lingual thyroid), maxillary or mandibular osteoporosis, accelerated dental eruption/premature loss of temporary teeth and burning mouth syndrome (Table 4) (Pinto and Glick, 2002).

As patients with hyperthyroidism are susceptible to cardiovascular diseases such as atrial dysrhythmias, it is essential that dentists address these patients' cardiac history by consulting their physicians before any invasive procedures. These procedures should be deferred in case of symptomatic patients (tachycardia, irregular pulse, sweating, hypertension, tremor, etc.) and uncontrolled status (Pinto and Glick, 2002).

The use of vasoconstrictors (epinephrine) deserves special consideration when treating patients with hyperthyroidism. Epinephrine can exacerbate symptoms of tachycardia, dyspnea and fatigue (Patton, 2015). Moreover, dentists should use a stress reduction protocol; they can prescribe drugs to control anxiety but some oral sedatives may potentiate antithyroid drugs (Patton, 2015).

Table 4: Oral manifestations of hypothyroidism and hyperthyroidism

Hypothyroidism	Hyperthyroidism
-Macroglossia	-Increased susceptibility to caries
-Glossitis	-Severe periodontal disease
-Dysgeusia	-Extraglandular thyroid tissue enlargement (mainly lingual thyroid)
-Compromised periodontal health	-Maxillary or mandibular osteoporosis
-Salivary gland enlargement	-Accelerated dental eruption/premature loss of temporary teeth
-Delayed dental eruption	-Burning mouth syndrome
-Delayed wound healing	

Table 5: Thyroid dysfunction-considerations for dental treatments (Pinto and Glick, 2002)

Before treatment:
- Confirm the type of thyroid dysfunction
- Symptomatic thyroid dysfunction: Postpone elective treatment and consult the physician
- Uncontrolled thyroid dysfunction: Consult physician
- In case of cardiovascular disease: Assess cardiovascular status
- Patient under anticoagulation therapy: Make proper treatment modifications
- Assess drugs interactions
- Take blood pressure and heart rate: If abnormal, postpone elective treatment and consult the physician

During treatment:
- Oral examination: Check for oral manifestations (enlarged salivary glands, others)
- Controlled thyroid dysfunction: No contraindication to local anesthetic with vasoconstrictor
- Patient under non selective β-blockers: Avoid vasoconstrictors
- Uncontrolled thyroid dysfunction:
    - Only emergencies should be performed
    - Avoid vasoconstrictors
    - Minimize stress– short appointments
    - Discontinue treatment if any symptoms related to the thyroid dysfunction occur

After treatment:
- Control pain
- Patients with hypothyroidism: Sensitivity to central nervous system depressants and barbiturates
- Patients with hyperthyroidism: Use with precaution non-steroidal anti-inflammatory drugs and avoid aspirin
- Continue hormone replacement therapy or antithyroid drugs as prescribed

Finally, dentists should be prepared to take emergency measures while waiting the medical support if the thyrotoxic crisis clinical signs and symptoms occur. For that the following must be done: (a) Prevent hyperthermia by using cold towels to keep the patient cool, (b) administer intravenous hydrocortisone (100-300 mg) and hypertonic glucose if available and (c) monitor vital signs and be prepared for cardiopulmonary resuscitation if necessary (Patton, 2015).

Table 5 resumes dental treatments modifications in case of thyroid dysfunction as proposed by (Pinto and Glick, 2002).

Conclusion

Thyroid disorders are serious conditions. Dental practitioners should be familiar with their oral and general manifestations so they can recognize any complication and evaluate their control level. In case of an undiagnosed/uncontrolled dysfunction, all elective dental treatment should be postponed until a full medical assessment is performed. Moreover, dentists should be prepared to take emergency measures and ask for medical support if the clinical manifestations of the thyrotoxic crisis occur.

Ethics

The author declares no potential conflicts of interest related to authorship and publication of this article.

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