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INCIDENTAL PARATHYROIDECTOMY DURING THYROID SURGERY: REVIEW ARTICLE

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Abstract

Background: Thyroidectomy is one of the most common surgeries performed in iodine-deficient areas. An incidental parathyroidectomy (IP) during thyroidectomy is a possible complication of this operation. Improvement in surgical technique does not preclude the possibility of an inadvertent parathyroidectomy, which can occur even in the hands of competent thyroid surgeons. There is no unanimity on the clinical importance or risk factors of inadvertent parathyroidectomy. The parathyroid glands may be totally intrathyroidal and difficult to identify during surgery, particularly for the inferior glands in individuals with large goitres, or they may occasionally dwell beneath the thyroid capsule, leading in a 6 to 21% chance of inadvertent parathyroidectomy. Although the risk of permanent hypocalcemia is less than 2%, this can occasionally induce transitory hypocalcemia in 50% of instances.

Objective: This review aimed to provide an overview on operations incidental parathyroidectomy during thyroid surgery and Postoperative hypocalcemia and treatment.

Methods: The terms [Incidental parathyroidectomy, Thyroid surgery, and Hypocalcemia] were used to search PubMed, Google, and Google Scholar. Additionally, the authors limited the number of references they used to only the most recent or comprehensive study out of all the recognised studies and reviews in the pertinent literature.

Conclusion: Incidental parathyroidectomy is not rare after thyroidectomy, and in many cases, it may be attributed to the parathyroid glands' intrathyroidal position. Hypocalcemia is the most common complications among people who underwent an unintentional parathyroidectomy.

Keywords: Incidental parathyroidectomy, Thyroid surgery, Hypocalcemia.

Introduction

During thyroidectomies, accidental parathyroidectomy happens often. The incidence rates of unintentional parathyroidectomies have been evaluated in a few studies, and they range from 6.4% to 31.0% [1-2]. There are typically four parathyroid glands. However, this figure might be off, ranging from two to 192. The subcapsulary position is the most typical [3–4]. The oxyphil and parathyroid cells that make up the majority of the histology of these glands are derived from the third and fourth pairs of embryonic pharyngeal pouches [2]. The vascularization of the parathyroid gland is derived from the branches of the upper and lower thyroid arteries [5]. It is crucial to manage surgery carefully in order to maintain the parathyroid glands' vascularization[2].

During thyroidectomies, problems such hematomas, infections, keloid formation, and injury to the recurrent laryngeal nerve (RLN) occur at a rate of 5% [6]. The two most frequent side effects, hypocalcemia and RLN injury, are listed in decreasing order [1-4].

By devascularizing or inadvertently resecting the parathyroid glands, thyroid surgery raises the possibility of damaging the glands (incidental parathyroidectomy [IP]). Bilateral surgical treatments are still recommended in cases of severe thyroid cancer, multinodular goitres with compressive symptoms, or various forms of hyperthyroidism, such as Graves disease [9], despite the trend towards lowering the scope of surgical therapy [7-8].

The most frequent side effect following bilateral thyroid surgery is postoperative hypocalcemia [8, 10]. A lengthier hospital stay and higher medical expenses might result from transient hypocalcemia [11]. Permanent hypoparathyroidism can lead to serious clinical problems (such as nephrolithiasis and cataracts) and significantly lower patients' quality of life [12].

Overview

A thorough understanding of the vascular system, laryngeal nerves, and the anatomical interconnections and variances of the thyroid and parathyroid glands is essential for safe thyroid or parathyroid treatments. Throughout the first half of the 19th century, there were several catastrophic effects from early thyroidectomies, with a mortality rate of up to 40% [13]. During this period, thyroidectomy was recommended only in the most severe instances. A number of surgeons, most notably Billroth, Kocher, and Halsted, conducted extensive investigations of the thyroid's vascular architecture in an attempt to lower the procedure's morbidity and mortality. This procedure grew safer in the second part of the 1800s as knowledge of the anatomy of the arteries, parathyroid glands, laryngeal nerves, and thyroid increased. Furthermore, patient safety improved along with surgical instrument advancements [14]. The parathyroid glands include two distinct types of cells: the major cells and the oxyphil cells. Examining the cells reveals that they contain a well-developed endoplasmic reticulum and a noticeable Golgi apparatus, both of which help in the production and release of the hormone. Chief cells are more common than oxyphil cells, although they are smaller. What exactly Oxyphil cells are utilised for is unknown. They are larger than the original cells and seem to proliferate with age [15].

Understanding the architecture and embryology of the parathyroid glands is essential for a successful parathyroidectomy. The dorsal endoderm of the third and fourth branchial pouches gives birth to the parathyroid glands. Two superior and two inferior parathyroid glands make up the great majority of patients' total number of glands [16].

Originating from the third branchial pouch, the inferior parathyroid glands migrate first alongside the thymus before separating to occupy their ultimate location, which is typically located at the level of each thyroid lobe's inferior pole. The ultimobranchial bodies migrate first, and the superior parathyroid glands emerge from the fourth branchial pouch. They ultimately settle in the posterior region of the middle third of each thyroid lobe. Compared to the inferior thyroid glands, the superior parathyroid glands exhibit less anatomic diversity [17–18].

The thyroid gland has a more lobular surface, and the lymph nodes seem more pitted than the parathyroid glands, which have a clear, encapsulated, smooth surface. Because of factors including fat content, vascularity, and the proportion of oxyphil cells inside the glands, parathyroid glands are usually light brown to tan in colour. The golden hue might be mistaken for the fat that surrounds it. Additionally, there is a unique hilar artery that is visible if the surrounding fat does not cover the hila of the glands [19].

Primary hyperparathyroidism is the reason for the majority of parathyroidectomies. Parathyroid adenoma is the most prevalent cause of primary hyperparathyroidism, accounting for 75–90% of cases. The majority of parathyroid adenomas affect both parathyroid glands equally and are sporadic rather than genetic[20].

The homeostasis of calcium is influenced by the parathyroid glands. When serum ionised calcium concentrations are low, they produce parathyroid hormone (PTH), and when serum ionised calcium levels rise, the hormone's release is suppressed. PTH causes the kidneys to reabsorb calcium from the tubules more quickly than phosphorus. PTH raises blood calcium levels via acting on the gut and bone [21].

Anatomy and Physiology

Thyroid hormone, an endocrine gland with several vital physiological activities, is secreted by the thyroid gland. Thyroid dysfunction is a factor in the differential diagnosis for a similarly extensive variety of symptoms. Hypothyroid and hyperthyroid conditions both cause a very non-specific constellation of symptoms. However, cold sensitivity, dry skin, lethargy, constipation, pretibial edoema, and weight gain are the characteristic symptoms of hypothyroidism [18]. Weight loss, heat sensitivity, osteoporosis, tremor in the muscles, brittle hair or hair loss, and atrial fibrillation are all traditionally linked to hyperthyroidism [19]. Four parathyroid glands are located next to the thyroid gland, and their main job is to secrete PTH (also known as parathermone, or PTH) to control serum calcium levels [20–21].

Located in the anterior neck, the thyroid gland is invested in the middle layer of the deep cervical fascia. It is bounded anteriorly by the strap muscles, posteriorly by the trachea and pre-tracheal fascia, and laterally by the carotid arteries. The thyroid isthmus connects the left and right thyroid lobes, which are located anterior and lateral to the trachea, at the midline. In most

cases, the thyroid is attached via the pretracheal fascia between the second and third tracheal rings [22]. Furthermore, the pyramidal lobe, an embryologic remnant running superiorly from the thyroid isthmus, is present in 15–75% of individuals. The lobe can range in size from 3 mm to 6 cm [23]. The pyramidal lobe can either extend superiorly to attach to the thyroid cartilage or the hyoid bone, or it can be linked to the thyroid alone. Remarkably, pre-operative imaging frequently fails to detect the existence of a pyramidal lobe [23].

The parathyroid glands are located directly next to the thyroid gland and are distinguished by their brownish-yellow colour in contrast to the yellow colour of fat globules. Traditionally, the superior parathyroid glands are located about 1 cm above the point where the inferior thyroid artery (ITA) and the RLN meet on the posterolateral part of the superior pole. According to one description, the inferior parathyroid glands are situated between the inferior thyroid vein and artery, close to the inferior side of the thyroid lobe [24]. Despite being more erratic in placement than the superior glands, the inferior parathyroid glands are significant in that they lie ventral, or anterior to, the plane of the RLN. The superior parathyroid glands are located dorsal, or posterior, to the nerve's plane. Ectopic and/or supra-numerary parathyroid glands are present in a small but considerable proportion of individuals. These glands can be seen anywhere from the mediastinum to the inferior border of the jaw [25].

Indications

Thyroid nodules, hyperthyroidism, obstructive or substernal goitre, differentiated thyroid cancer (follicular or papillary), medullary thyroid cancer (MTC), anaplastic thyroid cancer, primary thyroid lymphoma (for which surgery is limited to obtaining tissue biopsy), and metastases to the thyroid from extrathyroidal primary cancer (most frequently lung and renal cell cancer) are among the benign and malignant conditions for which thyroidectomy may be performed [26].

Globally, thyroid nodules are a phenomena that affect 1% of men and 5% of women clinically. Just 5% of nodules are cancerous; the bulk of nodules are benign. Thyroid nodules are detectable with high-resolution ultrasound in as many as 68% of randomly chosen people who have a screening ultrasound, with a preference for older adults and women [27].

Goitre was traditionally treated by a thyroidectomy. The majority of goitres and many thyroid nodules with benign features no longer require thyroidectomy because to advancements in diagnostic imaging and medical therapy. In addition, the prevalence of thyroid nodules has led to a wealth of research that has helped identify which nodule features call for surgery vs observation, saving a great number of individuals from needless thyroid surgery. For microcarcinoma in differentiated thyroid cancer, such as papillary thyroid cancer (PTC), lobectomy may be necessary. In PTC, size >1cm, tall cell variations, extrathyroidal expansion, bilateral disease, and lymphovascular invasion are indications for complete thyroidectomy rather than lobectomy [28]. In the event of a known or suspected thyroid cancer, evaluation of the regional lymph nodes should be carried out during any thyroid ultrasonography, and FNA should be taken into consideration for any larger or atypical nodes [29].

Contraindications

Thyroidectomy has few real contraindications. Patients who are thinking about having a thyroidectomy should be informed about the changing risk/benefit profile with age, as thyroid cancer often progresses slowly[30].

Anaplastic carcinoma's poor prognosis and tendency towards fast development make it a therapy challenge. If there is no indication of metastases and if complete resection can be accomplished with little morbidity, surgical resection may be recommended. In any other case, surgical intervention might not be appropriate [31].

In the context of Hashimoto's or Graves' illness, surgical criteria that are deemed relative contraindications to outpatient surgical therapy include enormous goitre, widespread substernal goitre, locally advanced malignancy, poor hemostasis, and a tough thyroidectomy [32].

Thyroid Imaging, laboratory testing and Laryngeal examination

Thyroid imaging: The gold standard for preliminary thyroid imaging is ultrasonography. In certain instances, other imaging modalities like magnetic resonance imaging (MRI) or computed tomography (CT) are used to determine the degree of advanced illness [17].

Laboratory testing: To ascertain the patient's euthyroid, hyperthyroid, or hypothyroid status prior to surgery, a blood level of thyroid-stimulating hormone (TSH) is necessary for every patient.

Laryngeal examination: Vocal cord paresis or paralysis may arise from damage to the RLN after thyroid surgery. It is advised to evaluate the voice before to surgery, and if anomalies are found, specialised, flexible fiberoptic laryngoscopy should be considered. For some patients and skilled surgeons, outpatient thyroidectomy is usually regarded as safe; nonetheless, the operating surgeon makes the final decision about the course of treatment [33].

Surgical Techniques

With strong evidence supporting its use in the treatment of both benign and malignant thyroid disease, thyroidectomies are significant surgical procedures [34].

An essential component of treating thyroid disorders is the surgical Techniques utilised in thyroidectomies. Surgeons have been safely removing the thyroid gland whole or in part for many years using a variety of techniques [35]. Thyroid surgery is often carried out by the open surgical technique, which entails creating a large incision in the anterior neck and extracting the thyroid gland through it [36]. Excellent vision, excellent access to the thyroid gland, parathyroids, and RLNs, as well as superb control over the surgical field, are all made possible by transcervical incision [37]. Thyroid cancer is often treated with the normal open method, which might leave a noticeable scar on the neck. Because of their diminished self-confidence, patients may have severe quality of life reductions [38–40].

In thyroid surgery, there is currently a focus on developing alternative, cosmetically favourable surgical methods that eliminate or minimise the anterior neck incision, taking into account the cosmetic aspect, the desire to minimise perioperative and postoperative

complications, and the 2015 ATA guidelines [16]. These advancements centre on minimally invasive methods including natural orifice surgery, the trans-axillary approach (TAA), and the bilateral axillo-breast approach (BABA). For certain patients, these techniques could provide safer solutions, but as they are still in their infancy and experimental stages, the surgeon's training and experience are essential to guaranteeing the patient's safety [41].

Parathyroidectomy: Similar to thyroid surgery, a Kocher incision is a low cervical incision that is made around two fingerbreadths above the suprasternal notch. It is typically between two and four centimetres long. The subplatysmal flaps are elevated when the platysmal muscle is further dissected. In the event that a localization examination indicates a unilateral problem, that side's thyroid is activated first [40].

Complications

As with any surgical surgery, haemorrhage and infection are possible side effects of parathyroidectomy. These problems should be uncommon as parathyroidectomy is a clean procedure and careful homeostasis is essential to its success [8].

Hemorrhage: Severe instances might be fatal and result in airway compression.

Hypoparathyroidism: causes hypocalcemia, which, if ignored or mistreated, can develop into symptoms that are potentially fatal. Following a complete thyroidectomy, up to one-third of individuals will experience at least brief hypocalcemia. To reduce associated issues following a complete or completion thyroidectomy, it's critical to stick to a regular approach for managing calcium levels [27].

Injury to the RLN: causes aspiration as well as hoarseness. This is often transient, but in less than 1% of cases, it could be permanent [8].

Injury to the superior laryngeal nerve: causes a shift in voice pitch. The range of reported injury rates is 0% to 58% [28].

Postoperative hypocalcemia and management

Postoperative hypocalcemia is characterised by reduced PTH production, which frequently results in hyperphosphatemia and hypocalcemia. The normal postoperative reaction to surgical stress, which includes hemodilution and the production of antidiuretic hormone, also lowers total blood calcium levels. Total serum calcium is roughly 50% ionised, 40% albumin-bound, and 10% complexed with phosphate or citrate [42].

The likelihood of post-thyroidectomy hypoparathyroidism has been investigated in various studies. An independent calcium level does not predict hypocalcaemia as well as a postoperative PTH level. The predictive value is improved by evaluating the relative PTH reduction [43].

During the perioperative phase, patients are given oral calcium supplementation with vitamin D (cholecalciferol) starting a week before surgery and continuing for two weeks following. This reduces the incidence and severity of postoperative hypocalcemia, hence improving the patient's quality of life [44].

The last guideline is to routinely screen for vitamin D deficiency (25-OH- VitD3 levels less than 20 ng/ml) before surgery. Vitamin D3 levels should be evaluated at the first appointment, and supplements should be prescribed as needed. It is most common to provide 100,000 IU of oral cholecalciferol. After two months of recuperation from surgery, a second Vitamin D3 level should be obtained. Vitamin D insufficiency is best identified at the initial consultation [42].

If the patient has symptoms (paresthesia, neuromuscular excitability), frequent calcium and vitamin D supplementation is recommended. Typically, the initial dose of calcium carbonate is 500-1000 mg. Calcium citrate can be utilised if there is underlying achlorhydria since calcium carbonate requires an acidic environment for gastrointestinal absorption (e.g., with PPIs). First, 0.5 to 1 micrograms of vitamin D in the form of calcitriol are given twice daily [42].

Dosages should be adjusted weekly based on calcium and phosphate levels to achieve biological balance. Magnesium deficiency, which may cause PTH resistance, must be identified and treated (1.5 g magnesium per day). Calcium salts reduce the bioavailability of levothyroxine, hence the first calcium dose of the day should be administered several hours after the thyroid hormone replacement dose [43].

Conclusion

Incidental parathyroidectomy is not rare after thyroidectomy, and in many cases, it may be attributed to the parathyroid glands' intrathyroidal position. Incidental parathyroidectomy might be viewed as a potentially avoidable but clinically modest consequence of thyroid surgery. Hypocalcemia is still the most common complications among people who underwent an unintentional parathyroidectomy.

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