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Parathyroid Gland Injuries during Total and Subtotal Thyroidectomy

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Abstract

The aims of present study are to find out the incidence of the incidental parathyroid excision (IPE) during thyroidectomy and its effects on the postoperative calcium levels and also to evaluate the factors underlying. The current study examined the incidence of IPE during thyroid surgery. We found the incidence rate of IPE in our patients to be 16.4% and that compares favorably with the rates reported in the literature. In this randomized prospective study we surveyed 30 patients in the period from November 2012 till March 2014. All the patients had been presented with benign thyroid diseases including: cases of simple multinodular goiter, cases of diffuse toxic goiter relapsing after full medical treatment, cases of secondary toxic goiter, cases of thyroiditis and cases of solitary thyroid nodule. All the patients had indications for thyroidectomy. All the patients had been subjected to full clinical assessment. The operating surgeon should also keep in mind the anatomical variations of the parathyroid glands to avoid inadvertent injury, devascularization, or resection of the parathyroid parenchyma. There is a wide variability in the number of parathyroid glands, but in most individuals, there are 4, each approximately 6 mm to8 mm in diameter and located extra capsularly on the posterior surface of the thyroid gland. The superior parathyroids are commonly located at the superior pole of the thyroid, while the location of the inferior parathyroids is more variable, and is sometimes intrathymic. However, dissection in the search for all parathyroid glands during thyroid surgery is not advisable and may be hazardous. As expected in total thyroidectomy, bilateral dissection increased the risk of parathyroid removal. This may be related to the fact that dissection bilaterally puts all four glands at risk. In addition, in the current study, total thyroidectomy was done mainly for malignant thyroid disease, and malignancy was reported to be a strong predictor of IPE in earlier studies. The association between thyroiditis and an increased risk of IPE can be accounted for by the formation of scar tissue as a result of inflammation and by increased bleeding, both of which may cause operative difficulties. Although extra thyroid extension was not found to be a risk factor in a recent study, in the present study, we found it to be another strong predictor of IPE. Extra thyroid extension occurs in malignant lesions, and patients undergoing surgery for thyroid malignancy, particularly with a more aggressive approach, are at a high risk. However, in our series, age and sex were not found to carry any risk for IPE. The association of completion thyroidectomy with IPE has been reported extensively in literature. In our study, completion thyroidectomy was not found to be a strong risk factor, despite the surgical difficulties expected with the re-exploration of the neck. Incidental parathyroidectomy may occur even in the hands of more experienced thyroid surgeons.

Keywords: Parathyroid gland injuries; Total and subtotal thyroidectomy

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Introduction

Thyroidectomy is a commonly performed procedure for thyroid problems. Incidental removal of the parathyroid glands is one of its recognized complications, which occurs more frequently in certain high-risk patients [1]. The literature shows a finding of parathyroid glands ranging from 6.4% to 31% in pathological specimens of the thyroid [2]. Most of the times, there are four parathyroid glands. The most commonly location is subcapsulary. These glands develop from the third and fourth pairs of embryonic pharyngeal pockets, and its histology is made up mainly of oxyphil and parathyroid cells. The parathyroid gland vascularization is from branches of the superior and inferior thyroid arteries. During surgery, it is essential to handle it with care, so as to preserve the vascularization of the parathyroid glands. The rate of complications, such as hematomas, infection, keloid and damage to the recurrent laryngeal nerve during thyroidectomies is 5%. The two most

Table 1: Mean ages for all cases.

Sex	Mean age (years)	Range (years)	Standard deviation
Females	40	20-60	10,82
Males	35	25-45	10,00
Total	39.5	20-60	10,69

Table 2: Frequency of cases according to sex.

Sex	Number	Percentage
Females Males	27	90%
Total	30	100%

common complications are recurrent laryngeal nerve damage and hypocalcemia [3]. The aim of this study was to identify the incidence, risk factors, and clinical relevance of incidental parathyroid excision (IPE) during thyroid surgery.

Patients and Methods

In this randomized prospective study we surveyed 30 patients. All the patients had been presented with benign thyroid diseases including:

- Selected cases of simple multinodular goiter.
- Selected cases of diffuse toxic goiter relapsing after full medical treatment.
- Selected cases of secondary toxic goiter.
- Selected cases of thyroiditis.
- Selected cases of solitary thyroid nodule.

Methods

All the patients had been subjected to the followings:

Preoperative assessment

A- Full clinical assessment:

- History: A complete history sheet was taken from each case.
- Examination: General and thyroid examination were done for each case. Thyroid examination was done as follow.
- Inspection: Each patient was setting up and the neck was extended and examination of the thyroid gland by inspection was done for its site, shape size, movement up and down with deglutition, surface, skin, and the surrounding structures.
- Palpation: It was done from behind using the fingers of both hands with the thumb over the nape after lowering the chin to relax neck muscles Palpation was done for each lobe at time tilting the head to the same side. Examination of thyroid gland by palpation was done for temperature, tenderness, site, size, shape, surface, consistency edges and surrounding structures.
- Percussion: It was done on the manibrum and medial ends of the first inter costal space.
- Auscultation: It was done over the upper pole.

B- Routine laboratory studies: Blood samples were collected using conventional vein puncture and when it was necessary to use tourniquet to assist vein puncture it was removed for thirty seconds before collecting the samples. All hematological parameters (CBC, kidney function, liver function, RBS) preoperatively, one week postoperatively and three months postoperatively Fasting blood samples were used for measurement of serum calcium and the results were corrected to an albumin level 4 g/l by adding or subtracting 0.09 mg/dl for every 0.1 g/dl deviation in albumin.

C- Thyroid profile: The following laboratory investigations were done, preoperatively, one week postoperatively and three months postoperatively free T3, free T4, TSH were The specimens were taken from the venous blood of each patient and put in a test tubes and then centrifugation was done and serum was separated and kept at 20 cc until investigations were done by enzyme immune assay technique [4].

D- Neck ultrasonography: Neck ultrasonography was done for detection of gland consistency, retrosternal extension, tracheal deviation, and cervical lymphadenopathy.

E- Thyroid Scan: When indicated was done for detection of the nature of the gland (toxic-non oxic) and the nature of the nodules (hot- warm- cold).

F- Referral to ENT specialist: For indirect laryngoscope to determine the mobility of the vocal cords and more for medico legal reasons.

Surgical technique

Under general anesthesia, the patients is placed on a supine position on the operating table, placing a sand bag between the shoulders and a ring under the head so that, the patient neck is extended, it is important that, the neck should not be over extended as this will increase the postoperative pain.

The skin is prepared with antiseptic solution (povidone iodine) and a four towel square to applied and secured with towel clips. The operating surgeon stands on the right side of the patient. The skin incised two finger breadths above the clavicle and suprasternal notch parallel to the skin crease. The incision extends between the posterior border of the sternocleidomastoid muscles. The subcutaneous tissue is cut in the same line of skin incision and the platysma is cut slightly above the line of skin incision (for neat scar result) until reaching the strap muscles and applying meticulous heamostasis.

The superior skin flap is raised by applying two allis forceps on the platysma and pulling them vertically by the assistant to demonstrate the space between the platysma and strap muscles by dissecting superficial to the deep cervical fascia and anterior jugular vein using the counter traction to facilitate the dissection (just above the junction between the upper flap and the underlying deep cervical fascia). Usually we do not divide the anterior jugular vein unless they are enlarged and interfering with dissection or the gland is huge. We always use both blunt and sharp dissection with Diathermy or ligating any blood vessels in the way.

The Allis forceps are removed and the midline raphe is identified (pale white) between the strap muscles. Sometimes the midline may be pushed if one lobe is hugely enlarged and the overlying strap muscles are stretched very thin.

The fascia on either side of midline is picked up and the deep cervical fascia is incised and extended superiorly and inferiorly using scissor and diathermy until the thyroid gland is seen. Some small blood vessels (or the anterior jugular tributaries) traverse the bloodless midline and are secured by diathermy to maintained bloodless field. Then by cutting through several thin layers of fascia the thyroid gland surface is displayed.

Table 3: Total and subtotal thyroidectomy.

Type of operation	Number of patient	Percentage
Total thyroidectomy	27	90%
Subtotal thyroidectomy	3	10%
Total	30	100%

Table 4: The presenting symptoms (main symptoms) of all patients (30 patients).

The presenting symptoms	Number of patient	Percentage
Swelling and disfigurement	18	60%
dyspnea	11	36.67%
dysphagia	1	3.33%
total	30	100%

The medial edge of strap muscles is held with small Langenbeck retractor and by dissecting between the thyroid lobe and muscle laterally to mobilize the lobe. The space is large enough, a larger Langenbeck retractor is placed in the space, which should be bloodless, and is enlarged by a gauze pledget dissection around the lobe of the gland. We do not divide the strap muscles unless the gland is huge.

We used to stand with the same side of the gland lobe to be dealt with, the strap muscles are retracted laterally and upwards by two Langenbeck retractors and the lobe is pulled medially and the space between them is developed using a pledget till identifying the middle thyroid vein (if present) which is then ligated by 3/0 synthetic absorbable ligature (Vicryl) and divided, this allows the lobe to be mobilized more medially and anteriorly. The operator moves his body to face the patient head to deal with the superior pole. The gland is gently drawn downwards (by applying gauze on the gland surface or by gently applying a Kocher clamp near the upper pole) to aid identification of the superior pole vessels lying on the surface of the upper pole. The sometimes adherent sternothyroid muscle fibers are pushed off the surface of the upper pole with a pledget.

Then the medial space between the cricothyroid muscle and the medial edge of the upper pole is found (the cricothyroid space) and a small window is made through the fascia by artery forceps. Then the forceps is passed from medial to lateral (to avoid injury to the external laryngeal nerve) making a tunnel under the superior thyroid vessels which is then ligated by 2/0 Vicryl, the vessels should be skeletonized by gentle gauze dissection so the external laryngeal nerve is safeguarded.

We begin the dissection by looking specifically for Zuckerkandl's tuberculum on the lateral portion of the thyroid lobe. This tuberculum may be more or less easy to identify in about 65% of cases (because it can be more or less well-developed). When it is encountered, the tuberculum looks like an arrow pointing toward the nerve. The nerve lies in front when the tuberculum is a very small lateral projection (or only a thickening of the lateral edge of thyroid lobes), more frequently the nerve runs in a tunnel deep behind the tubercle. Because the relationship between Zuckerkandl's tuberculum and the laryngeal nerve is constant for embryologic reasons, medial retraction of the tuberculum, enables easy tracing of the nerve in the nearest position to the larynx where it is more vulnerable if left unexposed. After medial retraction of the partially mobilized thyroid lobe, the Zuckerkandle tubercle (If present) will be easy to identify, then we open up the tunnel, within which the recurrent nerve runs, it must opened at the top, dissecting the superior parathyroid gland from the end of the tubercle, step by step, The superior parathyroid gland, "untouched' with its intact supply, and the nerve are mobilized laterally from the thyroid, medially Berry's ligament can be best exposed and sectioned under visual control so that no residual thyroid tissue is left.

The recurrent laryngeal nerve is generally located in a fissure medial to the tubercle on the lateral surface of tracheal surface. Then we started to deal with the inferior thyroid veins by taking care of the recurrent laryngeal nerve, the inferior thyroid veins are isolated and ligated close to the gland. Then the gland is dissected from the trachea and after that we ligated inferior thyroid within thyroid capsule to avoid postoperative hypoparathyrodism.

Trunkal ligation of the inferior thyroid artery should be avoided to preserve the small arterial branches to the parathyroid glands. If necessary, a small remnant of normal thyroid tissue can be left in place to help preserve a parathyroid gland in situ. When a parathyroid gland cannot be preserved in situ, it is removed.

A small portion of the gland is submitted for frozen section examination to confirm the presence of parathyroid tissue. The remainder of the gland is minced, using a fresh 15 blade scalpel, to increase its surface area. The minced gland is then auto transplanted into a pocket of the sternocleidomastoid muscle. The pocket is closed with a non-absorbable suture. It is important to avoid hematoma formation when forming the pocket in the sternocleidomastoid muscle because this may jeopardize the viability of the auto transplanted parathyroid gland.

For total thyroidectomy, the lobe and the isthmus is dissected off the trachea up to its opposite anteromedial surface, then the operator change his position to deal with the other lobe in the same manner. After that, meticulous heamostasis is obtained after irrigating space, previously occupied by thyroid gland, by normal saline solution to identify small bleeding point which is then secured by diathermy. We do not use monopolar diathermy within one Cm around the recurrent laryngeal nerve or the parathyroid glands, while using a bipolar diathermy or suture ligation instead.

Closure is performed by approximation of the strap muscles using interrupted or continuous Vicryl 3/0 after insertion of rubber or tube drain in the space of the thyroid gland. The platysma is then approximated by interrupted inverted simple sutures using Vicryl 3/0 and the skin is closed by 3/0 polypropolene subcuticular sutures. Technical identification of the anatomical structures the Recurrent Laryngeal Nerve and the Inferior Thyroid Artery.

The best way to identify the recurrent laryngeal nerve is to stand on the opposite side of the patient, with the patient rotated toward you, and apply firm traction to the thyroid lobe pulling it upward and toward the midline, putting the tissues lateral to the thyroid under tension. This traction is best applied with a gauze sponge held in the surgeon's hand. Passing grasping instruments or sutures through the thyroid gland is less effective and may cause bleeding from the thyroid capsule or possible spreading of malignant cells [5].

During this traction, the fascia between the thyroid gland and the common carotid artery can be opened by a combination of sharp and gentle blunt dissection with a hemostatic forceps, starting laterally, the dissection should always be parallel, rather than perpendicular, to the anticipated course of the nerve [5].

The neurovascular intersection (where the inferior thyroid artery crosses the recurrent laryngeal nerve) should be identified, and a loop

placed around the trunk of the inferior thyroid artery. Slight tension applied to this loop facilitates further gentle dissection around the recurrent laryngeal nerve. This loop should be removed when the dissection has been completed. The inferior Thyroid artery should be ligated not truncally but peripherally on the capsule of the thyroid gland to preserve the vascular supply to the parathyroid glands [5].

The superior laryngeal nerve and the superior thyroid artery The dissection around the superior thyroid artery is made considerably easier by incision of the fascia in the midline as far as the sternal border and previous lateral mobilization of the thyroid lobe. After these procedures are completed, one can place a finger behind the superior pole and rotate it upward. The most critical structure to keep in mind when dividing the vessels of the superior pole is the external branch of the superior laryngeal nerve [6].

Postoperative care

All patients were informed that they have to take post operative medications (Hormonal replacement) for life with no chances for recurrence. Also patients were informed about all possible complications of total thyroidectomy. The thyrotoxic patients were prepared before surgery by using the following:

- Bed rest
- Carbimazole
- Propranolol

No patient is allowed to be operated upon unless becomes adequately prepared and well controlled and this is confirmed by:

- Pulse rate during sleep is around 72 beats/min.
- Absence of symptoms of thyrotoxicosis especially palpitation.
- T3, T4, TSH levels return to normal postoperative hypoparathyroidism was assumed when calcium and/or vitamin D was required to that clinical symptoms of hypocalcemia and I was considered permanent when calcium or vitamin D supplementation exceeds six months postoperatively to treat clinical symptoms of hypocalcaemia.

Results

This study was carried on 30 patients who had thyroid disease their ages were within the range of (20-60) years with a mean age of (39, 5) years for both sex mean age for male (35) years and for female (40) years (Table 1). A 27 patient were females (90%) and 3 patient were male (10%) (Table 2 and 3) showed 27total and 3 subtotal thyriodectmy.

Discussion

The aims of present study are to find out the incidence of the incidental parathyroid excision (IPE) during thyroidectomy and its effects on the postoperative calcium levels and also to evaluate the factors underlying its occurrence. Unintentional parathyroidectomy during thyroid resection is not uncommon, and it occurred in 16.4% of the cases in this series. Total thyroidectomy, extrathyroid extension of the tumor, and thyroiditis were found to be the risk factors for IPE. The two most common complications of thyroid resection include recurrent laryngeal nerve injury and hypocalcemia. These and other major complications typically occur in less than 5% of the cases. In the 21st century, thyroidectomy has become safe and effective with

Table 5: Indications for operations (main indications).

Indications	Number of patient	Percentage
Compression symptoms	12	40%
Fear of malignancy	10	33..33%
disfigurement	8	26.67
Total	30	100%

Table 6: Postoperative complications.

Complication	Number of patient	Percentages
Parathyroid gland injury	2	6.67%
hypothyroidism	1	3.33%
Hemorrhage and hematoma	-----	0.00%
infection	----	0.00%
Laryngeal nerve paralysis	----	0.00%
Acute respiratory failure	----	0.00%
mortality	----	0.00%

improved outcomes and minimal morbidity. Hypocalcemia is a major concern following thyroid surgery. The incidence of hypocalcemia was significantly higher among our patients with IPE in the first post-operative day. Injury, devascularization, and unintentional excision of the parathyroids have all been cited as the causes of postoperative hypocalcemia. As expected in total thyroidectomy, bilateral dissection increased the risk of parathyroid removal. This may be related to the fact that dissection bilaterally puts all four glands at risk. In addition, in the current study, total thyroidectomy was done mainly for malignant thyroid disease, and malignancy was reported to be a strong predictor of IPE in earlier studies. The association between thyroiditis and an increased risk of IPE can be accounted for by the formation of scar tissue as a result of inflammation and by increased bleeding, both of which may cause operative difficulties.

Although extrathyroid extension was not found to be a risk factor in a recent study, in the present study, we found it to be another strong predictor of IPE. Extrathyroid extension occurs in malignant lesions, and patients undergoing surgery for thyroid malignancy, particularly with a more aggressive approach, are at a high risk. However, in our series, age and sex were not found to carry any risk for IPE. The association of completion thyroidectomy with IPE has been reported extensively in literature.

In our study, completion thyroidectomy was not found to be a strong risk factor, despite the surgical difficulties expected with the re-exploration of the neck. Two recent studies have reported a significant association between inadvertent parathryoidectomy and neck dissection (central compartment clearance and modified radical neck dissection, respectively). This may be related to the more extensive dissection performed during a similar procedure.

In a feasibility study on endoscopic thyroidectomy, Gagner et al. [7] concluded that there was no significant difference in the rate of IPE between endoscopic and traditional open thyroidectomy.

Incidental parathyroidectomy may occur even in the hands of more experienced thyroid surgeons. However, in our series, age and sex were not found to carry any risk for IPE. The association of completion thyroidectomy with IPE has been reported extensively in literature.

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This is in part due to the awareness of the anatomical relationship of the parathyroid gland to the thyroid, which is important in preventing postoperative hypocalcemia. Nonetheless, the incidence of hypocalcemia following thyroidectomy remains significantly high in the range of 1.6% to 50%, with permanent hypocalcemia occurring in 1.5 to 4% of the cases. Regardless of surgeon experience, an incidental parathyroid gland features occasionally in the pathology reports of thyroid specimens.

Conclusion

Incidental parathyroidectomy may occur even in the hands of more experienced thyroid surgeons. Hypocalcemia is a major concern following thyroid surgery. The incidence of hypocalcemia was significantly higher among our patients with IPE in the first post-operative day. Injury, devascularization, and unintentional excision of the parathyroids have all been cited as the causes of postoperative hypocalcemia.

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