



Microanatomy of central compartment of neck and prediction of hypocalcemia with serial values of serum calcium in patients undergoing total thyroidectomy

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ABSTRACT:

Background: A thorough knowledge of the microanatomy of the central compartment is crucial in relating the structures to one another and identifying them. The aim of the study is to determine the potential role of intraoperative identification and preservation of parathyroid glands, by understanding its microanatomical relationship with the recurrent laryngeal nerve, and predicting the postoperative hypocalcaemia with serial values of serum calcium level.

Methods: A total of 70 cases where total thyroidectomy done were included in the study. Central neck dissection was performed ipsilaterally when size >4cms and extrathyroidal invasion noted. The microanatomical relationship of parathyroids in relation to the plane of recurrent laryngeal nerve was observed. Three samples of Serum calcium at immediate postop period, 6 hours after and 12 hours later were graphically depicted in a time value graph to predict the development of hypocalcemia postoperatively.

Results: A total of 70 patients over a span of two years from 2013 to 2015 were included in the study. Central compartment neck dissection was carried out in 43(61.4%) patients. The pathological types consisted of 57 (81.4%) papillary carcinomas, 04 (5.7%) medullary carcinomas, 02 (2.8%) follicular neoplasms and 07 (10.1%) benign diseases of thyroid. Left inferior parathyroids were found posterolateral in 68.5% and anterolateral in 27.1%. Right side parathyroids had variable positions with superior parathyroids in the anterior plane observed laterally in 71.4% and medially in 28.6% of cases. Right inferior parathyroids were found highly variable in all the planes, 47.1% anteromedially, 38.5% posterolaterally, 5.7% anterolaterally and 8.5% posteromedially. The graphical representation showed Upsloping curve in 34.2%, downsloping curve in 47.1% and 69.6% of them developed transient hypocalcemia. 18.7% of cases showed a plateau curve.

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Conclusion: A thorough understanding of microanatomical relationship of parathyroids in relation to plane of recurrent laryngeal nerve intraoperatively is advocated in preventing hypocalcemia and nerve injury. Left side parathyroids and right superior parathyroid gland are usually positioned lateral to the plane of nerve whereas right side inferior parathyroid gland showed varied positions. The downsloping curve in graphical representation of serial calcium values postoperatively predicts the patients vulnerable to develop hypocalcemia.

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INTRODUCTION

The inadvertent injury of parathyroid glands and recurrent laryngeal nerves during extensive thyroid surgeries, may result in profound influence in patient's quality of life. However, with meticulous surgical techniques and intraoperative monitoring, the recurrent laryngeal nerve palsy has been reduced to a minimum rate. Nevertheless, the incidence of postoperative hypocalcaemia and methods and ways to prevent and reduce its incidence still remains obscure. Intraoperative identification of the parathyroid glands is always a challenge even in hands of experienced surgeons and unintentional parathyroidectomy may be as high as 9% [1]. Transient hypoparathyroidism after total thyroidectomy estimated to range from 5% to 60% [2,3] and for permanent hypoparathyroidism from 0.5% to 2% [4]. Patients who developed hypocalcemia will eventually need to take oral calcium and vitamin D for a long time, which causes them significant discomfort. The most common factor for post-surgical hypocalcaemia was parathyroid gland injury, including an accidental resection or, most commonly, parathyroid "devascularization". To minimize parathyroid injury, a variety of techniques have been used for localization and identification of parathyroid glands, such as preoperative ultrasound, Sestamibi scintigraphy, computed tomography(CT), magnetic resonance imaging, and intraoperative intact parathyroid hormone assay [5]. Moreover, intraoperative methylene blue infusion [6], technetium-99 m-sestamibi [Tc-MIBI] localization using a hand-held gamma probe [7,8] and optical coherence tomography [9,10] may help maximize parathyroid preservation. These existing methods for identifying parathyroid glands are limited in

their applicability and sensitivity, rendering them inadequate to prevent surgical complications [11]. Also, these higher end instruments are usually not available in all centres especially in developing nations. Therefore, there remains a need for a way to accurately identify parathyroid glands during thyroid surgery, especially total thyroidectomy with central lymph node dissection for thyroid cancer. A thorough knowledge of the microanatomy of the central compartment hence, can always be relied upon in relating the structures to one another and identifying them. The aim of the study is to determine the potential role of intraoperative identification and preservation of parathyroid glands, and its relationship with the recurrent laryngeal nerve, and thus predicting the postoperative hypocalcaemia.

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MATERIALS AND METHODS

In our study, we included all the patients who underwent total thyroidectomy for carcinoma thyroid. According to our institutional protocol, ipsilateral paratracheal clearance was conducted in thyroid malignancies of > 4 cms size and with extrathyroidal invasion. If peroperative findings suggest nodal involvement on ipsilateral paratracheal region, then contralateral paratracheal clearance was performed. Surgery was done using loupe magnification and a thorough picture of microanatomy of central compartment including the relationship of recurrent laryngeal nerve and parathyroids were documented. In case of accidental resection of parathyroids, frozen section was done to confirm and the remaining tissue reimplanted in the forearm. We observed the serum calcium values at 3 occasions – immediate postoperative period,

after 6 hours of surgery and after 12 hours. Serum parathormone value was not checked vowing to shorter half life and expensive nature. The values of serum calcium were plotted in a time – value graph and the nature of the graph was correlated with the postop hypocalcemia, both transient and permanent. Calcium supplements weren't started in the immediate postop period. The patients were observed for clinical signs of hypocalcemia and were treated symptomatically. Those who developed permanent hypocalcemia were discharged with oral calcium supplements.

RESULTS

A total of 70 patients who underwent total thyroidectomy over a span of two years from 2016 to 2019 were included in the study. Among them 51(72.8%) were female and 19(27.2%) were male. Patient demographics, histopathological diagnosis, are described in Table 1. Central compartment neck dissection was carried out in 43(61.4%) patients. The pathological types consisted of 57 (81.4%) papillary carcinomas, 04 (5.7%) medullary carcinomas, 02 (2.8%) follicular neoplasms and 07 (10.1%) benign diseases of thyroid. The parathyroidal positions in relation to the plane

of recurrent laryngeal nerve bilaterally are depicted in the picture 1. Left side parathyroids were seen predominantly on the lateral aspect of recurrent laryngeal nerve due to their medialised course in the tracheoesophageal groove. Left inferior parathyroids were found posterolateral in 68.5% and anterolateral in 27.1% of the cases. Right side parathyroids had variable positions with superior parathyroids in the anterior plane observed laterally in 71.4% of cases and medially in remaining 28.6% of cases. Right inferior parathyroids were found highly variable in all the planes, 47.1% anteromedially, 38.5% posterolaterally, 5.7% anterolaterally and 8.5% posteromedially.

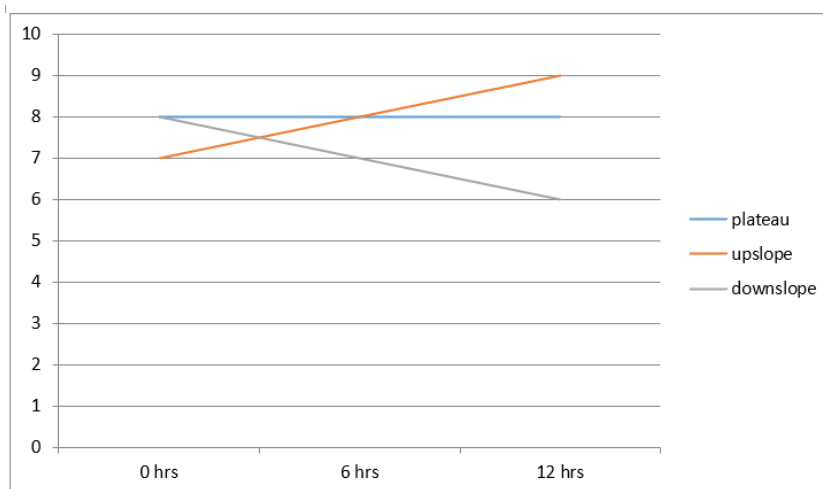
The graphical representation of serum calcium levels are shown in picture 2. Upsloping curve was seen in 34.2% and none of the patients developed neither transient nor permanent hypocalcemia. Downsloping curve was noticed in 47.1% of cases and 69.6% of them developed transient hypocalcemia. 18.7% of cases showed a plateau curve indicating same level of serum calcium in all the 3 samples and none developed hypocalcemic symptoms in this group of patients.

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Table 1: Demographics

Variables	Number	Percentage
Sex		
male	19	27.2
female	51	72.8
Histopathology		
Papillary carcinoma	57	81.4
Medullary carcinoma	04	5.7
Follicular neoplasm	02	2.8
Benign disease	07	10.1





Graph 1: Graphical representation of serum calcium values

Table 2: Hypocalcemia in accordance with the serum calcium value curve

Serum Calcium level	Numbers (Percentage)	Transient hypocalcemia
Upsloping curve	24 (34.2)	Nil
Downsloping curve	33 (47.1)	23 (69.6)
Plateau curve	13 (18.7)	Nil

DISCUSSION

In several studies, postthyroidectomy hypoparathyroidism has been reported with a varying incidence, ranging from less than 1% to 15%.[12] This may be due to a variety of factors, such as injury, devascularization of the parathyroid glands, and accidental resection of one or more parathyroid glands, probably, however, the cause of postoperative hypocalcaemia is multifactorial. During thyroidectomy, preservation of the parathyroid glands can be achieved by careful dissection directly on the thyroid capsule separating the parathyroid glands gently from the thyroid capsule.[13]. Familiarity with the anatomy of parathyroid glands and their blood supply is necessary to prevent inadvertent injury/devascularization or resection of parathyroid parenchyma. However, even the most experienced thyroid surgeon performing a meticulous dissection can be surprised by a pathology report stating that an incidental parathyroid gland was found in the submitted thyroid specimen. The variable location of the parathyroid glands (particularly the

intracapsular or intrathyroid location in some cases) contributes to the risk of incidental parathyroidectomy. In the present study, 57.7% of the parathyroid glands resected unintentionally were within the thyroid gland which is comparable to that (40–50%) reported in recent studies [14]. Hence, even with improvement in surgical techniques, the risk of incidental parathyroidectomy cannot be eliminated. Cadaver dissection, however have shown that normal intrathyroid parathyroid glands are more uncommon, occurring in less than 1% of population[15].

In this study, studying extensively about the microanatomy of the parathyroids on both sides helps us in identifying them precisely and avoiding unnecessary damage to them, thus preventing hypoparathyroidism in the postoperative period. The parathyroidal positions were thoroughly studied in relation to the plane of recurrent laryngeal nerve bilaterally. Left side parathyroids were seen predominantly on the lateral aspect of recurrent laryngeal nerve due to their

medialised course in the tracheoesophageal groove. Left inferior parathyroids were found posterolateral in 68.5% and anterolateral in 27.1% of the cases. This finding was helpful in both preserving the nerve and the blood supply to parathyroids while dissecting.

Whereas the right side parathyroids had variable positions with superior parathyroids in the anterior plane observed laterally in 71.4% of cases and medially in remaining 28.6% of cases. Right inferior parathyroids were found highly variable in all the planes, 47.1% anteromedially, 38.5% posterolaterally, 5.7% anterolaterally and 8.5% posteromedially. This was highly due to the oblique course of the right recurrent laryngeal nerve angulating with the trachea and midline. The right inferior parathyroids were highly variable in their location posing high rate of damage and difficulty in dissection of glands and nerve.

Taking into considerations of the microanatomy of the gland positions, the nerve was identified in all cases before identifying the parathyroids, so as to study the plane of relation between them. Most of the time, the superior parathyroids were identified first during dissection before the nerve, and the dissection was carried out in the inferior lobe once the superior pole is dissected and superior pedicle ligated. This norm was followed throughout and hence it became a protocol in all our thyroid surgeries. Large goitres and extracapsular spread of the thyroid disease sometimes, ruins this anatomical relation and the protocol has to be broken at times.

We observed the serum calcium values at 3 occasions – immediate postoperative period, after 6 hours of surgery and after 12 hours. The graphical representation of serum calcium levels shows Upsloping curve in 34.2% and none of the patients developed neither transient nor permanent hypocalcemia. Whereas Downsloping curve was noticed in 47.1% of cases and 69.6% of them developed transient hypocalcemia, indicating that hypocalcemia is prone to develop in more than half of the patients who have downsloping curve of serum calcium. The rest of 18.7% of cases showed a

plateau curve indicating same level of serum calcium in all the 3 samples and none developed hypocalcemic symptoms in this group of patients.

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