

HYPOCALCAEMIA AFTER THYROID SURGERY PREDICTION, PREVENTION AND MANAGEMENT

Thesis

*Submitted for Partial Fulfillment for the M.D. Degree
in General Surgery*

By

Naglaa Lotfy Ahmed
M.B., B.Ch., M.Sc.

Supervised By

Prof. Dr. El Sayed Abd El Mauty El Mahrakawy
*Professor of General Surgery
Faculty of Medicine, Ain Shams University*

Prof. Dr. Hassan Sayed Tantawy
*Professor of General Surgery
Faculty of Medicine, Ain Shams University*

Prof. Dr. Mohamed Naguib
*Professor of General Surgery
Faculty of Medicine, Ain Shams University*

Prof. Dr. Yaser Abd El Rehim
*Professor of General Surgery
Faculty of Medicine, Ain Shams University*

**Faculty of Medicine
Ain Shams University
2013**

List of Contents

<i>Title</i>	<i>Page No.</i>
List of Tables	ii
List of Figures	iii
Introduction	1
Aim of the work	3
<u>Review of literature</u>	
• Surgical anatomy and embryology of the thyroid gland and its related structures	4
• Surgical anatomy and embryology of the parathyroid gland and its related structures	22
• Pathophysiology of calcium metabolism	29
• Post thyroidectomy hypocalcaemia of other complications of thyroidectomy	41
• Management and prevention of post thyroidectomy hypocalcaemia	55
Patients and Methods	67
Results.....	74
Discussion	118
Conclusion	125
Summary	127
References.....	132
Arabic Summary	--

List of Tables

<i>Table No.</i>	<i>Title</i>	<i>Page No.</i>
Table (1):	Age and sex distribution in the two groups; (40 patientst).	75
Table (2):	Histopathological varities in group A (Type I).	79
Table (3):	Ca levels pre-operative and 1 st day, 3 rd day and 1 month post-operative.	79
Table (4):	PTH levels pre-operative and 1 st day post-operative.	80
Table (5):	Pre & post-operative levels of Ca & PTH of the case suffered of hypocalcaemia in group A (Type I) after hemi-thyroidectomy.....	80
Table (6):	Histopathological varities in group A (type II) after subtotal thyroidectomy.	82
Table (7):	Ca level Pre-operative 1 st day, 3 rd day and 1 month post-operative.	83
Table (8):	PTH level Pre-operative and 1 st day post-operative.	83
Table (9):	Pre-operative, post-operative levels of Ca and PTH in the patient with just biochemical hypocalcaemia in group A (type II) after subtotal thyroidectomy.	84
Table (10):	The pre-operative and post-operative Ca and PTH levels in the patient with manifest hypocalcaemia in group A (Type II) (subtotal thyroidectomy).....	85
Table (11):	Histopathological varities in group (B).....	91
Table (12):	Ca level pre-operative 1 st day, 3 rd day and 1 month post-operative in group B.....	91
Table (13):	PTH level pre-operative and 1 st day post-operative in group (B).	92
Table (14):	Pre-operative and post-operative levels of Ca and PTH in patients with manifest hypocalcaemia in group B (6 patients).	93
Table (15):	Pre-operative and post-operative levels of Ca and PTH in patients with biochemical hypocalcaemia in group B (1 patients).....	93

List of Tables (Cont....)

<i>Table No.</i>	<i>Title</i>	<i>Page No.</i>
Table (16):	Indication of thyroidectomy in group (A) and group (B).....	101
Table (17):	Comparison between incidence of post-operative hypocalcaemia in different histopathological varieties in group A and group B.	104
Table (18):	Comparison between normal cases and abnormal cases as regard the serum calcium level (per-operative, 1 st day, 3 rd day and one month post-operative) in group (A).....	105
Table (19):	Comparison between normal cases and abnormal cases as regard the serum calcium level (per-operative, 1 st day, 3 rd day and one month post-operative) in group (B).....	106
Table (20):	Comparison between normal cases and abnormal cases as regard PTH level (per-operative, 1 st day, 3 rd day and one month post-operative) in group (A).	107
Table (21):	Comparison between normal cases and abnormal cases as regard PTH level (per-operative, 1 st day, 3 rd day and one month post-operative) in group (B).....	108
Table (22):	Comparison between abnormal cases in group A and group B as regard serum Ca level (preoperative, 1 st , 3 rd and one month post-operative).	109
Table (23):	Comparison between abnormal cases in group A and group B as regard serum PTH level (preoperative, 1 st and one month post-operative).	110
Table (24):	Incidence of hypocalcaemia in relation to preservation of parathyroid glands in group (A) type II and group B.	112
Table (25):	Incidence of hypocalcaemia in relation to preservation and ligation of main trunk of inferior thyroid artery in group A (type II) and group and group B.	114
Table (26):	All patients with hypocalcaemia.....	115
Table (27):	Follow up of patients with manifest hypocalcaemia under treatment done every month for six months (8 patients).	117

List of Figures

<i>Fig. No.</i>	<i>Title</i>	<i>Page No.</i>
Fig. (1):	Cross sectional anatomy of the neck at the level of mid thyroid gland.....	7
Fig. (2):	Arteries and veins supplying and draining the thyroid gland.....	10
Fig. (3):	Relation of the internal and external branches of the superior laryngeal nerve to the superior thyroid artery at the upper pole of the thyroid gland	14
Fig. (4):	Course and relations of the recurrent laryngeal nerve	16
Fig. (5):	Various relations at crossing of the recurrent laryngeal nerve and the inferior thyroid artery (A-C) common variation, (D) non recurrent, (E) partially descended	18
Fig. (6):	Lymphatic drainage of the thyroid gland	21
Fig. (7):	Location of upper parathyroid glands	24
Fig. (8):	Location of lower parathyroid glands	25
Fig. (9):	Recognition of the possible shapes of the parathyroid gland will assist in successful identification of the parathyroids during neck exploration	27
Fig. (10):	Position of the hands in hypocalcaemic tetany (carpopedal spasm)	55
Fig. (11):	Gender distribution in the study.	74
Fig. (12):	Sex distribution between the two groups.	76
Fig. (13):	Mean age in the two groups.	76
Fig. (14):	Gender distribution in group A.....	77
Fig. (15):	Incidence of post-operative hypocalcaemia in relation to histopathological varieties in group A (Type II) after subtotal thyroidectomy.	87
Fig. (16):	Incidence of post-operative hypocalcaemia in relationship to preservation of parathyroid glands in group A (type II) after subtotal thyroidectomy.	88
Fig. (17):	Gender distribution in group B.....	90

List of Figures (Cont...)

<i>Fig. No.</i>	<i>Title</i>	<i>Page No.</i>
Fig. (18):	Incidence of post-operative hypocalcaemia in relation to histopathological varitis in group (B).....	95
Fig. (19):	Incidence of post-operative hypocalcaemia in relationship to preservation of parathyroid glands in group B.....	96
Fig. (20):	Incidence of post-operative hypocalcaemia in relationship to ligation of the main trunk of inferior thyroid artery in group (B).	98
Fig. (21):	Incidence of post-operative hypocalcaemia in group A and group B.....	100
Fig. (22):	Indicate of thyroidectomy in group A and group B.	102
Fig. (23):	Comparison between incidence of post-operative hypocalcaemia in different histopathological varities in group A and group B.....	104
Fig. (24):	Incidence of hypocalcaemia in relation to observation of parathyroid glands in group (A) type II and group B.	112
Fig. (25):	Incidence of hypocalcaemia in relation to preservation and ligation of main trunk of inferior thyroid artery in group A (type II) and group and group B.	114
Fig. (26):	Incidence of cases with biochemical and manifest hypocalcemia.....	116

INTRODUCTION

Thyroidectomy is one of the most common operations done today. The complications following thyroidectomy are well known, some of these can be fatal, others are quite disturbing particularly in their permanent form. The extent of resection, exposure of the recurrent laryngeal nerve, parathyroid gland identification, lack of surgical experience are all among risk factors which contribute for morbidity after thyroidectomy (*Herman et al., 2002*).

Hypocalcaemia is a common complication following thyroidectomy. Although permanent hypocalcaemia is rare, it can pose significant problems. The symptoms are often distressing especially when severe; many patients require prolonged treatment and follow up before calcium levels revert to normal. It was noticed that the incidence of biochemical and clinical Post-operative hypocalcaemia was relatively high despite efforts to identify and preserve as many parathyroid glands as possible (*See and Soo, 1997*).

The pathogenesis of transient hypocalcaemia after thyroid surgery is not fully understood. The incidence of hypocalcaemia is relatively much common after total thyroidectomy (6.9% to 25%) than after subtotal thyroidectomy or hemithyroidectomy (1.6% to 9.1%). Permanent hypocalcaemia, which could be defined as hypocalcaemia lasting two months or more after thyroid surgery, is due to vascular necrosis and/or accidental removal of the parathyroid glands (*Conn et al., 2006*).

Tetany, tingling around the mouth and in the distal extremities are commonly seen with hypocalcaemia. The appearance of these symptoms is thought to be related to the degree of speed of decrease in calcium levels after thyroidectomy (*Urano et al., 2006*).

The etiology of post thyroidectomy hypocalcaemia is still a debatable topic. Many factors such as excision, devascularization and of parathyroid glands are involved. Moreover, the influence of surgical experience on the incidence of post thyroidectomy hypocalcaemia may be relevant. The importance of preserving the parathyroid glands and their blood supply is still not properly evaluated (*Soon et al., 2005*).

Temporary hypocalcaemia may be contributed to calcitonin release due to operative manipulation of the thyroid gland, reactive hypoparathyroidism due to relative hypercalcemia in thyrotoxic patients (*See and Soo, 1997*).

AIM OF THE WORK

The aim of this study is to discuss causes of post thyroidectomy hypocalcaemia, its management and methods of prevention.

SURGICAL ANATOMY AND EMBRYOLOGY OF THE THYROID GLAND AND ITS RELATED STRUCTURES

If morbidity during and following thyroid surgery is to be minimized or avoided, and if high rates of success are to be achieved in restoring normocalcaemia in patients undergoing thyroid surgery, the surgeons must have detailed knowledge of the anatomy and embryology of the thyroid and parathyroid glands. The surgeon must be fully prepared to apply that knowledge during the course of operations on those organs (*Scott-Conner, 2001*).

Embryology of the thyroid gland

The thyroid, earliest glandular structure to appear, is recognizable in 4mms embryo by the end of the third week as a bulge on the floor of the foregut. This thyroid diverticulum is an endodermal pocket protruding between the first and second pharyngeal arches. This area is later evaginated to form median bud which appears during the later half of the fourth week and from which the thyroid gland develops (*Mann et al., 1995*).

It extends from the foreman caecum ventrally between the first and second pharyngeal arches then caudally in front of the remaining arches as far back as the commencement of the trachea. From its distal extremity the bilobed thyroid gland grows out, a portion of the distal extremity often remains as the pyramidal lobe. The thyroglossal duct passes ventral to the hyoid bone and it may

form a recurrent loop behind it. This is a common site of thyroglossal cyst. The duct may, however, occasionally passes behind or more rarely through the hyoid bone (*Undelsman, 2001*).

The developing gland, at first an irregular plate, develops two lateral wings connected by the isthmus. Follicles appear during the second month of gestation and increase through the fourth month. Colloid formation and uptake of radioactive iodine begin at about the eleventh week (*Krukowski, 2000*).

The ultimobranchial body which arises from a diverticulum of the fourth or fifth pharyngeal pouch of each side, amalgamates with corresponding lateral lobe. Parafollicular C-cells are derived from the neural crest and reach the thyroid via the ultimobranchial body (*Mann et al., 1995*).

Recently, consideration has been given to the possibility that some C-cells are of endodermal rather than neural crest origin (*Krukowski, 2000*).

Surgical anatomy of the thyroid gland and its related structures

Surgeons attempting operations on the thyroid gland must be well informed of the anatomy of the neck, including the thyroid gland, its blood supply and its nerve supply as well as the adjacent structures, the trachea, the larynx, the oesophagus and the

parathyroid glands. It is presented in a topographic manner describing the anatomy as it is encountered in thyroidectomy (*Henry, 2005*).

Thyroid gland

Is situated in the lower part of the neck. It consists of two symmetrical lobes united by an isthmus that lies in front of the second, third and fourth tracheal rings. The lobes lie on either side the larynx or trachea, extending from the oblique line of the thyroid cartilage to the sixth tracheal ring. It weights 25 gram in addition to its own capsule; the gland is enclosed by an envelope of pretracheal fascia (*Skandalakis et al., 1995*).

The lobes

Each lateral lobe is pear shaped, and appears approximately triangular on cross section with lateral, medial and posterior surfaces (*Fig.1*). The lateral surface is under cover of sternohyoid and sternothyroid muscles. The medial surface lies against the lateral side of the larynx and upper trachea, with the lower pharynx and upper esophagus immediately. This surface is related to cricothyroid muscle of the larynx, as well as to the external and recurrent laryngeal nerves. The posterior surface overlaps the medial part of the carotid sheath. The parathyroid glands usually lie in contact with this surface between it and fascial sheath (*Bellantone et al., 2002*).

The Isthmus

It joins the anterior surfaces of the lower parts of both lobes and is firmly adherent to the second, third and fourth tracheal rings. Its measurement is 1.25 cm transversely and vertically. A small portion of the gland substance often projects upwards from the isthmus, usually to the left of the midline, as the pyramidal lobe. It represents a development of glandular tissue from the caudal end of the thyroglossal duct. It is attached to the inferior border of the hyoid bone by fibrous tissue and muscle fibers. It is named levator glandulae thyroid and is innervated by a branch of the external laryngeal nerve (*Henry, 2005*).

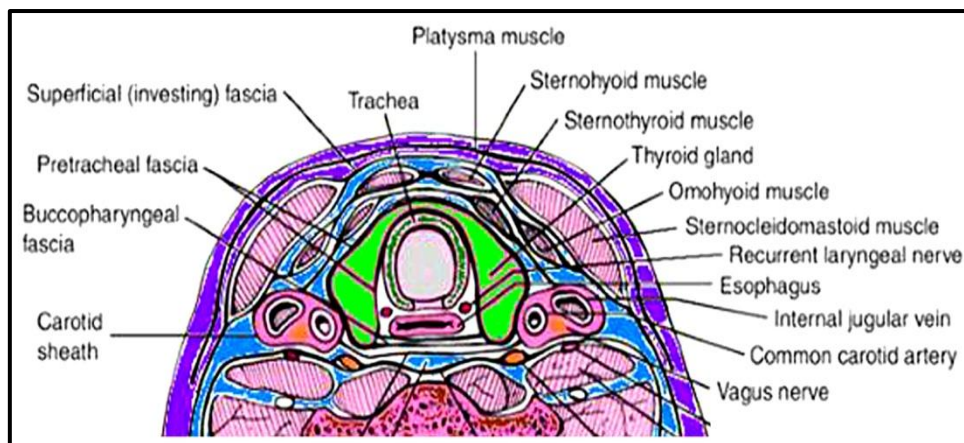


Fig. (1): Cross sectional anatomy of the neck at the level of mid thyroid gland (*Bellantone et al., 2002*).

The Capsule

The thyroid gland has a connective tissue capsule which is continuous with the septa that make up the stroma of the organ. This is the true capsule of the thyroid (*Bliss et al., 2000*). Outside

the true capsule lies a layer of fascia derived from pretracheal fascia and is known as the false or surgical capsule. Anteriorly and laterally this fascia is well developed, while posteriorly it is thin and loose, permitting enlargement of the thyroid gland posteriorly. There is a thickening of the fascia that fixes the back of each lobe to the cricoid cartilage. This thickening is called the suspensory ligament of Berry (*Skandalakis et al., 1995*).

The two ligaments, right and left, form a sling anchoring the gland to the larynx. They increase in size in large goitres, thus preventing the gland from falling away from the larynx the recurrent laryngeal nerve is in immediate contact with the back of the ligament. The numerous blood vessels of the thyroid gland pierce both the true and false capsules and then ramify to form a dense plexus of thin-walled vessels immediately beneath the inner or true capsule (*Decker and DuPlessis, 1996*).

Only the arterial and venous trunks traverse the space between the two capsules. The surgeon, in dealing with the thyroid, secures these main trunks between the capsules, exercising the utmost care not to wound the true capsule because of the numerous fragile vessels which lie just under it (*Decker and DuPlessis, 1996*).

The blood supply of the thyroid gland

The superior and inferior thyroid arteries constitute the main arterial supply. Occasionally, a branch from the aorta or innominate

artery, the lowest thyroid artery (arteria thyroidea ima) and the inferior thyroid veins (venae thyroidea ima) (*Conn et al., 2006*).

The veins

The superficial jugular veins lie beneath the platysma. The external jugular veins are lateral and cross over the sternocleidomastoid muscle. The anterior jugular veins immediately over line the sternohyoid muscles. A plexus of communicating veins may be present between the external and anterior jugular veins (*Russell et al., 2004*).

The deep thyroid veins leave the gland in relationship to the thyroid arteries mainly at the superior and inferior poles and the lateral aspect of the gland, they are less constant than the arteries in number, position, and size. The deep veins may be a serious threat during thyroid surgery because they are numerous and may be torn easily with ensuing hemorrhage (*Skandalakis et al., 1995*).

The superior thyroid vein leaves the gland at the superior pole just anterior and lateral to the superior thyroid artery. It empties into the internal jugular vein (*Van Hernden, 2006*).

The lateral or middle veins vary in number, they pass directly from the lateral border of the lobes and enter into the internal jugular vein. During thyroidectomy, they must be divided to permit access to the lateral compartment (fig. 2).