

## Original paper

# Incidence And Risk Factors Of Hypocalcemia After Thyroid Surgery

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## Abstract

**Background:** Hypocalcemia is a major post-operative complication of total thyroidectomy, causing severe symptoms and increasing hospitalization time. The primary cause is secondary hypo-parathyroidism following damage to, or devascularisation of, one or more parathyroid glands during surgery.

**Aim:** Is to determine the incidence of hypocalcemia after thyroid surgery and find out the risk factors involved leading to hypocalcemia regarding gender and body habitus, clinical diagnosis, extent of surgery, ligation of the inferior thyroid artery, pathology report and the experience of the surgeon.

**Material and method:** Prospective study of 100 patients in Al-Immamian Al-Kadhymian Medical City in period between November 2012-November 2013 included in subtotal, near total, total thyroidectomies. Serum calcium is estimated at day 1,2,3 postoperatively.

**Results and discussion:** Thirty patients developed hypocalcemia postoperatively, in 24 patients it was transient and in six patients was permanent (three of those six patients had underwent total thyroidectomy, the other two had underwent near total thyroidectomy and the last patient had underwent subtotal thyroidectomy).

**Conclusion:** Post-thyroidectomy hypocalcemia is relatively common phenomenon especially after extensive thyroid surgery.

**Keyword:** Hypocalcemia, thyroidectomy, postoperative.

## Introduction

Theodore Kocher is credited with refining the techniques of thyroidectomy and reducing the incidence of postoperative hemorrhage. He also recognized the importance of preservation of parathyroid glands.<sup>(1)</sup>

In total thyroidectomy we do bilateral total lobectomy with isthmusectomy. In near thyroidectomy we do total lobectomy in one side with subtotal lobectomy of the other side with isthmusectomy. In subtotal thyroidectomy, we do bilateral subtotal lobectomy with isthmusectomy.<sup>(1)</sup>

Postoperative hypocalcaemia is one of the complications of thyroidectomy; its incidence is more common after total thyroidectomy than after other more conservative thyroidectomies.<sup>(2)</sup>

The reported incidence of transient hypocalcaemia ranges from 1.6%- 9.3% after subtotal thyroidectomy and from 6.9%- 42% after total thyroidectomy. In contrast, permanent hypocalcaemia has been reported in 0.2 - 3% of patients after subtotal thyroidectomy and in 0.4 - 29% of patients after total thyroidectomy.<sup>(2)</sup>

It usually manifests itself in the first 24 hours post operatively or within the 2- 3 days after operation; however, very rarely the onset is delayed 2-3 weeks.<sup>(3)</sup>

In most patients it is transient that resolves spontaneously and only few patients develop permanent hypocalcaemia.<sup>(4)</sup>

The risk of this complication depends on the extent of surgery, the nature of the underlying disease and the experience of the operating surgeon. Furthermore, specific surgical problems are encountered in cases

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of recurrent thyroid disease, large goiter, anatomical variations, retrosternal or even mediastinal location and damage to the parathyroid glands. (5)

Hypocalcaemia is more frequent in extensive thyroidectomy when compared to minor resections of the thyroid gland, in the ligation of the inferior thyroid artery, and has been related to the surgeon's experience. (6)

The mechanism and pathogenesis of hypocalcaemia after thyroid surgery is not completely understood, however, it is attributed to surgical damage inflicted on the parathyroid glands during thyroidectomy; for example, direct injury, devascularization, or inadvertent removal, vascular injury is probably more common than inadvertent removal. (6)

Today, correct surgical technique is the most important factor in decreasing the incidence of hypocalcaemia. That means, in total thyroidectomy after ligation of middle thyroid vein we ligate superior thyroid pole near to the gland to avoid injury to external laryngeal nerve after that we ligate inferior thyroid artery after identification of recurrent laryngeal nerve, the artery must be ligated closely to the gland to avoid injury to parathyroid gland after separation of vessels we remove both lobes and isthmus. In near total thyroidectomy we do lobectomy of one site and small remnant of another lobe left with isthmusectomy while in subtotal thyroidectomy a small remnant of each lobe left with isthmusectomy. (7)

Other causative mechanisms that have been implicated in the pathophysiology of post-thyroidectomy hypocalcaemia include calcium uptake by bone in patients with thyrotoxic osteodystrophy, parathyroid suppression from increased calcium restored from the bone of patients with hyperthyroidism, transient post-operative hemodilution with increased renal excretion of calcium, increased release of calcitonin as a result of thyroid manipulation. (8)

The first clinical sign of hypocalcaemia may be less typical and may include numbness and tingling sensation around the mouth and in the distal extremities. (9)

Physical examination reveals positive Chvostek's sign (contraction of the facial muscles elicited by tapping on the facial nerve anterior to the ear) and Trousseau's sign (carpopedal spasm which is elicited by occluding blood flow to the forearm with a blood pressure cuff for 2 to 3 minutes). (9)

Tetany, which is characterized by tonic-clonic seizures, carpopedal spasm and laryngeal stridor may prove fatal and should be avoided. Hypocalcaemia causes significant and distressing symptoms and increases in medical costs and it creates a great deal of apprehension on the part of the physician because of immediate and long term complications. (10)

Chronic complications are intracranial calcification, particularly of the basal ganglia, various mental disturbances, such as irritability, depression and even psychosis, papilledema and other signs of increased intracranial pressure have been reported. Chronic hypocalcaemia may lead to cataract formation and abnormalities of the skin and nails. (10)

Mild asymptomatic hypocalcaemia does not require calcium supplementation, while in patient with severe disturbances or symptoms of hypocalcaemia, intravenous supplementation should be implemented and patients should be released with oral calcium and vitamin D regimen until the hypoparathyroidism resolves. (11)

Intravenous calcium gluconate can be given 10-20 ml of 10% solution slowly until the symptoms disappear then 50 ml of 10% calcium gluconate can be added to 500 ml of 5% dextrose solution and administered by intravenous drip at a rate of 1 ml/kg/h. (12)

The parathyroid glands are usually four in number, a superior and inferior on either side, however, the numbers vary from two to six. Ninety per cent are in close relationship to the thyroid, 10 per cent are aberrant, the latter invariably being the inferior glands. Each gland is about the size of a split pea and is of a yellowish-brown color.

The superior parathyroid is more constant in position than the inferior gland. It usually

ties at the middle of the posterior border of the lobe of the thyroid above the level at which the inferior thyroid artery crosses the recurrent laryngeal nerve. The inferior parathyroid is most usually situated below the inferior artery near the lower pole of the thyroid gland. The next commonest site is within 1 cm of the lower pole of the thyroid gland.

Aberrant inferior parathyroids may descend along the inferior thyroid veins in front of the trachea and may even track into the superior mediastinum in company with thymic tissues, for which there is an embryological explanation.<sup>(13)</sup>

Less commonly, the inferior gland may lie behind and outside the fascial sheath of the thyroid and be found behind the esophagus or even in the posterior mediastinum. Only on extremely rare occasions are the glands actually completely buried within thyroid tissue.<sup>(13)</sup>

The aim of this study is to determine the incidence of hypocalcemia after thyroid surgery and find out the risk factors involved leading to hypocalcaemia regarding gender and body habitus, clinical diagnosis, extent of surgery, ligation of the inferior thyroid artery, pathology report and the experience of the surgeon.

## Patients and Methods

This prospective study was carried out on 100 patients who underwent thyroid surgery for various thyroid diseases at the surgical department of AL-Immamaine AL-Khadmin medical city in the period between November 2012 to November 2013.

The patients included were only those who underwent subtotal, near total and total thyroidectomies.

The data form included gender, body habitus, clinical diagnosis, thyroid function status, type of surgery, ligation of the inferior thyroid artery. Pathology report and whether the surgery performed by consultants, senior registrars or residents.

Each patient had serum calcium, phosphate and total serum protein measured

preoperatively and at day 1, 2, 3, postoperatively.

Patients who had postoperative hypocalcaemia were followed up as outpatients and had serial checking of their serum calcium levels.

A calcium level of 8 mg/dl (2 mmol/L) on at least 2 consecutive measurements was considered as a threshold value of hypocalcaemia, in addition; experiencing symptoms as perioral and digital paresthesia and having Chvostek's and Trousseau's sign was also included in definition.

It was considered transient if it resolved within 6 months and permanent if it persisted after 6 months and the patient is maintained on supplementation therapy of calcium and vitamin D.

Patients who had clinical evidence of hypocalcaemia {circumoral and acral (fingers and toes) paresthesia, and carpopedal spasm were given i.v calcium gluconate 10-20 ml of 10% solution until the signs and symptoms disappear. Some patients require the dose to be given 2-3 times per day.

Patients who had permanent hypocalcaemia were given oral calcium and vitamin D supplementations and were followed up on regular outpatient checking up visits.

The histopathological report was reviewed and the results were compared with the state of hypocalcaemia.

## Results

A total of 100 patients underwent thyroidectomy in the period between November 2012 to November 2013 at the surgical department of AL-Immamaine AL-Khadmin medical city.

92 patients were females and 8 were males.

The majority of patients (72%) had simple multinodular goiter, (10%) had Grave's disease, (8%) had toxic nodular goiter, (6%) had thyroiditis, and (4%) had cancer. According to FNA cytology results (table 1). Total thyroidectomy was performed for 9% of patients, near total thyroidectomy for 22% of patients and subtotal thyroidectomy for

69% of patients. Table (2).  
 Thirty patients developed hypocalcaemia postoperatively; in 24 patients it was transient and in six patients was permanent. Three patients out of six patients who developed permanent hypocalcaemia had underwent total thyroidectomy and the other 2 had underwent near total thyroidectomy and the last patient had underwent subtotal thyroidectomy. Table (3) p-value=0.001  
 All the four patients with CA(2cases had medullary carcinoma stage III,1case had follicular carcinoma stageII,1case had anaplastic carcinoma stageII had post thyroidectomy hypocalcaemia, while 4 patients (66.66%) of patients with thyroiditis had hypocalcaemia and only 5 patients(50%) of those with Grave's disease had hypocalcaemia, and 3 patients( 37.55%) of those with toxic nodular goiter had hypocalcaemia and only 14 patients( 19.45%) of those with simple multi nodular goiter had hypocalcaemia. Table (4). p-value=0.006  
 22 patients out of the 24 (91.66%) who developed transient hypocalcaemia were females, and 5 patients out of the 6 (83.33) who developed permanent hypocalcaemia were females also. Table (5). p-value = 0.501  
 Thirty one patients were operated on by a

consultant surgeon, and 7 patients out of those (22.5%) had hypocalcaemia, 19 patients were operated on by a senior registrar and 6 patients of those (31.5%) had hypocalcaemia and 50 patients were operated on by the residents and 17 patients of those (34%) had hypocalcaemia. Table (6). p-value = 0.54  
 All of the patients who underwent total and near total thyroidectomy (31 patients) had underwent a bilateral ligation of the inferior thyroid artery, 20 patients of them (66.6%) had hypocalcaemia, while 30 patients out of the 69 who underwent subtotal thyroidectomy had underwent a unilateral ligation of the inferior thyroid artery, and only 10 of them (33.4%) had hypocalcaemia postoperatively. Table (7) p-value = 0.01  
 All the 8 patients who developed hypocalcaemia following total thyroidectomy were of normal or underweight body habitus, with only one patient out of the 10 who had hypocalcaemia following near total thyroidectomy was obese and of a short neck and two patients out of the 12 who had hypocalcaemia following subtotal thyroidectomy were obese and of a short neck also. Table (8).

**Table 1.** Distribution of 100 patients who underwent surgery according to various thyroid diseases

Thyroid Disease	Number of patients
Multinodular Goiter/simple	72
Grave's disease	10
Toxic nodular goiter	8
Thyroiditis	6
Cancer	4

**Table 2.** Distribution of 100 patients according to the type of the surgical procedure for various thyroid diseases

Type of Surgery	Number of Patients	MNG	CA	Thyroiditis	Grave's	Toxic Nodular Goiter
Total Thyroidectomy	9	0	4	0	3	2
Near Total Thyroidectomy	22	9	0	2	6	5
Subtotal Thyroidectomy	69	63	0	4	1	1

**Table 3.** Distribution of 100 patients who underwent surgery according to the type of the surgical procedure and its related transient and permanent hypocalcaemia

Type of Surgery	Number of Patients	Hypocalcemic	Transient	Permanent
Total Thyroidectomy	9	8	5	3
Near Total Thyroidectomy	22	10	8	2
Subtotal Thyroidectomy	69	12	11	1

**Table 4.** Distribution of 100 patients who underwent surgery according to the type of the surgical procedure, histopathological report and their related hypocalcaemia

Type of Surgery	Number of patients	Hypocalcaemia	MNG	CA	Thyroiditis	Grave's	Toxic Nodular Goiter
Total Thyroidectomy	9	8	-	4	-	3	1
Near Total Thyroidectomy	22	10	4	-	2	2	2
Subtotal Thyroidectomy	69	12	10	-	2	-	-

**Table 5.** The incidence of hypocalcaemia in relation to the gender of the patient

Gender	Hypocalcaemia		Total
	Permanent	Transient	
Male	1	2	3
Female	5	22	27
Total	6	24	30

**Table 6.** the incidence of hypocalcaemia in relation to the operator.

Surgeon	Number of patients	Hypocalcemic	Percentage (%)
Consultant	31	7	22.5
Registrar	19	6	31.5
Resident	50	17	34

**Table 7.** The incidence of hypocalcaemia in relation to the ligation of the inferior thyroid artery

Ligation of the Inferior Thyroid Artery	Hypocalcaemia				Total	
	Present		absent			
	No.	%	No.	%	No.	%
Bilateral	20	66.6	11	35.4	31	50.9
Unilateral	10	33.4	20	64.6	30	49.1
Total	30	49.1	31	50.9	61	100.0

**Table 8.** The incidence of hypocalcaemia in relation to the body habitus of the patient

Type of surgery	Number of patients	Hypocalcemic	Obese and short neck
Total Thyroidectomy	9	8	0
Near Total thyroidectomy	22	10	1
Subtotal Thyroidectomy	69	12	2

## Discussion

Postoperative hypocalcaemia is a not rare complication of thyroid surgery, mortality is seen due to hypocalcemia but morbidity is rare but most often it is a transient event that occurs after extensive thyroid surgery which is similar to Pramod K Sharma et al study.

The result of our study showed that the incidence of hypocalcaemia is 30% and it was transient in the majority of the cases,

which is similar to F.M. Al-Mohamed et al study.

Regarding the type and extent of the surgical procedure, we found that the incidence of transient hypocalcaemia was 55.5% after total thyroidectomy, while it was 36.3% after near total thyroidectomy and it was only 15.9% after subtotal thyroidectomy . (p-value = 0.001) which is significant.

The incidence of permanent hypocalcaemia was 33.3% after total thyroidectomy while it was 9% after near

total thyroidectomy and only 1.4% after subtotal thyroidectomy.

These figures are consistent with those reported in other studies (Antonio Jose Goncalves et al) that showed that the extent of resection and surgical technique has greater impact on the rate of post-thyroidectomy hypocalcaemia (p-value=0.01).

Regarding the ligation of the inferior thyroid artery, we found that 66.6% of the patients who underwent bilateral ligation of that artery had post-thyroidectomy hypocalcaemia, while 33.4% of the patients who underwent a unilateral ligation of that artery had hypocalcaemia, so making that procedure as an important risk factor. (p-value = 0.01) which is significant. These figures are consistent with those reported in other studies (Rehan Masood et al).

Regarding the experience of the operator, we found that the incidence of post-thyroidectomy hypocalcaemia in patients whom surgery was performed by consultant surgeon was 22.5%, while in those operated on by registrar was 31.5% and those whom operated on by residents was 34%. (p-value = 0.54) which is not significant. These figures are consistent with those reported in other studies (Mary Shomon et al).

Regarding the clinical and the pathological diagnosis, we found that All the patients with CA had post thyroidectomy hypocalcaemia (p-value = 0.006) which is significant, while 66.66% of patients with thyroiditis had hypocalcaemia (p-value = 0.06) and only 50% of those with Grave's disease had hypocalcaemia, and 37.55 of those with toxic nodular goiter had hypocalcaemia and only 19.45 of those with simple multinodular goiter had hypocalcaemia.

These findings are in agreement with other studies (which is similar to Thomusch et al study). which showed that the thyroid cancer is a risk factor for inadvertent parathyroid excision.

Regarding the body habitus of the patient,

we found that only 10% of the patients who had post-thyroidectomy hypocalcaemia were obese and of a short neck, so making that parameter is not so significant (p-value=0.6).

## Conclusion

We can conclude that transient post-thyroidectomy hypocalcaemia is relatively common phenomenon (30%) especially after extensive thyroid surgery. Its incidence is related to the extent of the surgical procedure especially if this was associated with bilateral ligation of the inferior thyroid artery at its trunk and it can be only reduced by the use of the proper technique.

## Recommendations

We can reduce the incidence of hypocalcemia by:

1. Identification of the patients at risk (total thyroidectomy, CA).
2. Apply the correct surgical technique.
3. After identification of the recurrent laryngeal nerve, ligate the branches as close to the thyroid gland and preservation of the parathyroid glands.
4. Re Implantation of the inadvertently excised glands into a sternocleidomastoid muscle pocket.
5. Early postoperative measurement and estimation of calcium level to anticipate presence of hypocalcemia to keep the patients on observation and treated them early.

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