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# IS IT SAFE NOT TO LIGATE THE INFERIOR THYROID ARTERY DURING SUBTOTAL THYROIDECTOMY?

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## Abstract

Thyroid surgeries are common operations with an extremely low mortality. It is associated with specific morbidities which are dramatically decreased due to the rapid progression in operative techniques which helped to make the thyroid surgery less feared and better understood than it once was. Inferior thyroid artery is one of the vital structures that require special attention during operative technique in order to avoid troublesome and in most cases a preventable complications.

We conducted this study to assess the: Prevalence and significance of post-operative hypoparathyroidism following thyroid surgery, with or without inferior thyroid artery ligation. Incidence of recurrent laryngeal nerve injury with or without inferior thyroid artery ligation. Intraoperative and post operative bleeding with or without inferior thyroid artery ligation.

A prospective observational study was done from June 2005 to June 2008, at Basrah General Hospital. One hundred and eight patients underwent subtotal thyroidectomy. Majority of them (90) patients were females. Patients were placed in two groups, Group I had inferior thyroid artery ligation whereas in Group II, inferior thyroid artery was not ligated.

Analysis of data reveals that (50%) of patients in group I had hypocalcemia, (16.1%) recurrent laryngeal nerve injury and (4.83%) hematoma, whereas in group II (47.82%) had hypocalcemia, (8.7%) recurrent laryngeal nerve injury and (2.17%) hematoma.

Statistically, there is no significant difference regarding post-operative hypocalcaemia, recurrent laryngeal nerve injury and hematoma formation between truncal ligation and non-ligation of inferior thyroid arteries.

## Introduction

*Thyroid vessels must be ligated somewhere. Should they be so ligated as not to cut off the blood supply of parathyroid glandules? Replying to this question is impossible without definite knowledge of the blood supply to these little bodies, Halsted& Evans-1907*

It is a well known that almost all the blood supply to the four parathyroid glands comes from the inferior thyroid artery, i.e. about 80-86% of blood supply to the superior parathyroid glands were comes from inferior thyroid artery and 90-95% of lower parathyroid glands blood supply originates from the inferior thyroid artery also[1]. Theodor Kocher is credited with refining the techniques of thyroidectomy and reducing the incidence of intraoperative and postoperative hemorrhage. He also recognized the importance of preservation of blood supply to parathyroid glands[2]. Hypocalcaemia or hypoparathyroidism is among the well recognized complications of thyroid surgery and its incidence is a sensitive measure of the quality of thyroid surgery[3].

Postoperative hypocalcaemia is a relatively frequent situation after subtotal thyroidectomy, with a related incidence of as high as 83%. It can be transitory with regression in six months or, in some cases, permanent. It is a very unpleasant situation for the patient. When intensive, it can be life threatening and is therefore a very serious complication. So it is a logical inference that this procedure may increase postoperative hypocalcaemia[4].

Inadequate production of parathyroid hormone leads to hypoparathyroidism and the resulting hypocalcemia, may be permanent or transient. The rate of permanent hypoparathyroidism is (0.4-13.8%). The condition may be due to direct trauma to the parathyroid glands, devascularization of the glands, or removal of the glands during surgery[5].

The rate of temporary hypocalcemia is reportedly (2-53%)[6]. The cause of transient hypocalcemia after surgery is not clearly understood. It may be attributable to temporary hypo-parathyroidism caused by reversible ischemia to the parathyroid glands, hypothermia to the glands, or release of endothelin-1. Endothelin-1 is an acute-phase reactant known to suppress parathyroid hormone production, and levels have been elevated in patients with transient hypoparathyroidism[7].

The inferior thyroid artery has been described as an important landmark for identifying the recurrent laryngeal nerve[8]. However, its relationship to the nerve is subject to variation, Figure (1).

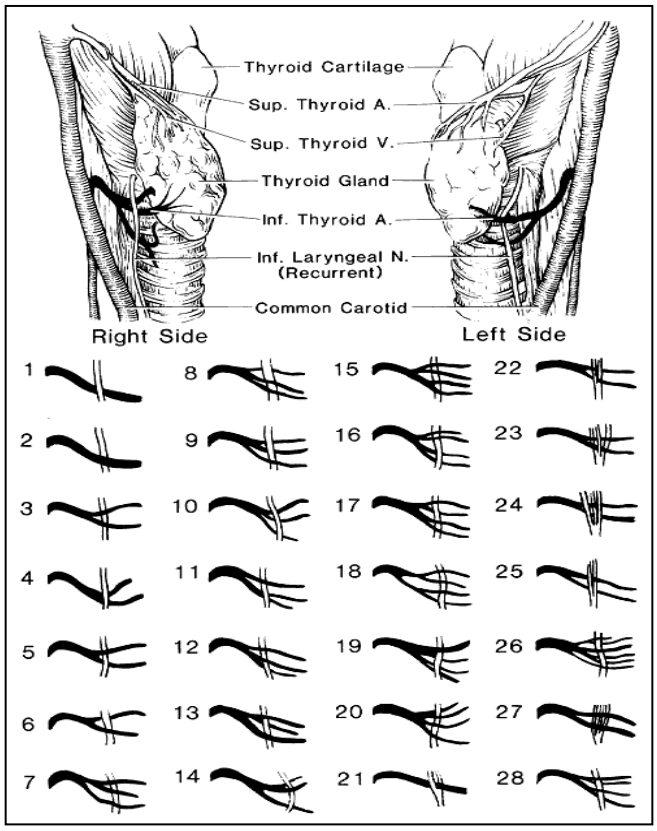


**Fig.1: The relations of the inferior laryngeal nerve to the inferior thyroid artery[8]**

Classic descriptions of the recurrent laryngeal nerve hold that they ascend in the tracheoesophageal groove; however, they may in fact be lateral to it. Low in the neck, the course of the right recurrent laryngeal nerve is relatively oblique and lateral and, probably, more prone to injury than the left recurrent laryngeal nerve. The nerve may branch several times before entering the larynx[8,9].

Numerous descriptions and attempts to quantify the percentages of each relationship of the nerve to the artery have been put forth. Percentages of variation differs on the right and left sides[8,10].

- On the right, the nerve runs between branches of the artery in approximately (50%) of patients.

The nerve is anterior to the artery in (25%) and posterior in (25%).

- On the left, the nerve courses posteriorly to the artery in (50%) of patients; in approximately (35%), the nerve runs between branches. In only (15%) it is anterior to the artery.
- The recurrent laryngeal nerve may exist as two bundles on one side.
- Non recurrent laryngeal nerve may exist in (1%) of people.

In summary, *the nerve is always near the artery*, but the exact relationship cannot be determined with certainty. Therefore, the inferior thyroid artery is one of the important landmarks for identifying this nerve[8,11].

Mechanisms of injury to the recurrent laryngeal nerve include[8,12]:-

1- **Complete or partial transaction.** thick connective tissue called the Berry ligament attaches the thyroid to the trachea at the level of the second or third tracheal ring. This is the most common site of injury to the recurrent laryngeal nerve. The nerve may run deep to the ligament, pass through it, or even penetrate the gland a short distance at this level.
2- **Traction**. retraction of the thyroid lobe may result in traction injury and make the nerve susceptible to transection.
3- **Contusion.**
4- **Crush.**
5- **Burn.** It is better not to use a unipolar diathermy near the nerve.

Moreover, the bipolar diathermy must be used carefully and only in a few cases.

6- **Misplaced ligature.**

Bilateral partial recurrent laryngeal nerve injury if happened, can be a life threatening event and may change the lifestyle of our patients completely[12]. There is no doubt that the intraoperative bleeding stains the tissues and obscures important structures. Moreover, intraoperative bleeding in thyroid surgeries increases the risk of other anatomic complications. So deliberate dissection and fastidious hemostasis are essential to prevent recurrent laryngeal nerve injuries and also to prevent the postoperative bleeding and hematoma formation[9-12].

Postoperative bleeding can be a devastating complication of thyroid surgery. An unrecognized or rapidly expanding hematoma can cause airway compromise and asphyxiation. The incidence of hemorrhage after thyroid surgery is low (0.3-1%), but the surgeon must be aware of this potentially fatal complication[12,14].

From the observation of these complications we want to answer the important question, is it safe to ligate or not to ligate the inferior thyroid artery in subtotal thyroidectomy in order to prevent the recurrent laryngeal nerve injury, hypocalcaemia and intraoperative bleeding with subsequent hematoma formation.

## Patients and methods

This prospective, observational study (case control study) was carried out in the surgical department of Basrah General Hospital, from June 2005 to June 2008.

We chose to limit our study to those patients with subtotal thyroidectomy, because in this kind of thyroid surgery, the risk of direct damage of the parathyroid gland or its thin vascularization is about the same in all patients. All patients who required subtotal thyroidectomy were included, except those patients:-

1- with low pre-operative serum calcium.
2- who could not complete follow up.
3- with recurrent goiter.
4- with thyroid malignancy. excluded from our study to avoid the problem of patient compliance or preexisting risk factors that makes the possibility of

complications are very high and absolutely will changes the course of classical subtotal thyroidectomy.

All patients were admitted one day before surgery and thorough clinical, biochemical and histopathological evaluation and preoperative workup protocol was followed in form of:-

**1**-Routine preoperative investigations [hemoglobin (Hb)%, packed cell volume (PCV), blood sugar and blood urea].

**2**-Thyroid function tests triiodothyronine (T3), tetraiodothyronine (T4), thyroid stimulating hormones(TSH).

**3**-Serum calcium, serum albumin to calculate the corrected value of ionized calcium, in the follow up of hypocalcemic patients to avoid the effect of hypoalbuminemia on serum calcium values.*

4-Electrocardiogram (ECG).

5-Ultrasonic thyroid gland assessment.

6-Fine needle aspiration for cytology in selected patients when needed.

**7**- We looked for Chvostek's and Trousseau's signs preoperatively because they occur in (5-15% ) of the normal people[15].

** The normal range of serum calcium was ( 8.5-10.5) mg/dl.*

*it is equal to (2.1-2.6)mmol/L, and the conversion factor to SI units is (0.25).*

** Corrected total calcium (mg/dl) = [measured total Calcium (mg/dl) + 0.8 x (4.0 - serum albumin (g/dl))]*

*Where (4.0) represents the average albumin level. *Normal serum albumin = (3.1-4.3) gm/dl = (31-43) gram/L.(15)*

**8**-Otolaryngologist consultation to document the vocal cord function.

**9**-Informed consent with explanation to our patients the possible postoperative complications.

10-Postoperatively-Serum phosphate and serum magnesium, are important minerals to be assessed postoperatively in the follow up of any patients with hypocalcemia that is not respond to calcium therapy, because in this setting it is difficult to reverse hypocalcaemia without magnesium repletion.*Serum magnesium is important for the synthesis and release of parathyroid hormone. In hypomagnesaemia, the release of parathyroid hormone is inhibited, leading to potentially severe hypocalcaemia[18].

One hundred and eight patients were included in this study and divided into two groups. In group I (62) patients, main trunks of inferior thyroid arteries were ligated ,where as in group II (46) patients, the inferior thyroid artery was not ligated.

All the patients were operated by a two consultant surgeons of the same unit. One of these surgeons has an attitude to do inferior thyroid artery ligation in all of subtotal thyroidectomies, while the other senior not performed this ligation.

Immediate postoperative vocal cord examination was a mandatory step. Serum calcium level measurement was done one day before surgery, and in third post operative day. Further follow up clinically and biochemically on the seventh day postoperatively ,three and six months later, in all those with complications.

Patients showing features of hypocalcaemia, hematoma and recurrent laryngeal nerve injury were readmitted or followed for assessment depending upon the condition of the patient. All preoperative, operative and postoperative findings were recorded in details and statistical analysis and evaluation was done.

** Normal value of serum magnesium is (0.7-1.0) mmol/L, i.e.(1.4-2) mEq/L.*

*Factor of conversion to SI units is( 0.5).(18)*

**Procedure**

Subtotal thyroidectomy was done by a same standard technique in both groups, each superior thyroid vascular pedicle was divided between ligatures, in group I the trunk of each inferior thyroid artery was simply ligated.

Same steps in group II but with the technique of capsular dissection. On each

side a (4–6) grams remnant of thyroid tissue was left in place. The parathyroid glands were identified according to routine protocol.

The thyroid is a highly vascular organ and bleeds copiously. Therefore, we take care to avoid traumatizing the thyroid tissue during this procedure. Avoiding the use of cauterization near the critical areas and we take in consideration the anatomical variation of right and left recurrent laryngeal nerves. Before closing the wound, we irrigate it, address all residual bleeding.

Finally, we advice the use of light neck dressings. A dressing that covers the wound may mask hematoma formation, delaying its recognition should it occur. Routinely we use the drain and its use not to substitute for intraoperative hemostasis.

In group I, two cases required immediate parathyroid autotransplantation ,and this is was done by dividing the parathyroid gland into multiple pieces of (1)mm fragments and implanted into pockets made in sternocleidomastoid muscle. While in the other group, no gland required reimplantation. One case required immediate reintubation and tracheostomy was done (because of bilateral recurrent nerve injury).

Postoperatively, all patients were clinically examined and questioned for symptoms of hypocalcaemia, such as: weakness, fatigue, irritability, circumoral parasthesia and numbness, cramps, anxiety, and depression.

Laboratory tests were obtained again on four occasions by measurement of total calcium, albumin, phosphate and magnesium, in all patients with hypocalcaemia.

## Results

During the study period, 90 women and 18 men were operated on; their ages ranged from (11–75) years. The mean age in group I was (37.3) years, with a standard deviation of (12.6). In group II, the mean age was (39.17) years, with a standard deviation of (12.3), as shown in table I.

| Age group | Patients with inferior thyroid artery ligation | | Patients without inferior thyroid artery ligation | | Total |
|---|---|---|---|---|---|
| | Females | Males | Females | Males | |
| 11-20 | 4(8%) | - | 4(8.7%) | - | 8(7.4%) |
| 21-30 | 17(34%) | 1(8.3%) | 7(15.2%) | 3(50%) | 28(26%) |
| 31-40 | 13(26%) | 1(8.3%) | 13(28.3%) | 2(33.3%) | 29(26.8%) |
| 41-50 | 7(14%) | 4(33.3%) | 10(21.7%) | 1(16.7%) | 22(20.4%) |
| 51-60 | 8(16%) | 5(41.7%) | 5(10.9%) | - | 18(16.7%) |
| >60 | 1(2%) | 1(8.3%) | 1(2.2%) | - | 3(2.8%) |
| Total | 50(81%) | 12(19.4%) | 40(86.7%) | 6(13%) | 108(100%) |

**Table I: Distribution of patients according to their age. The applied Chi squared test revealed that the two groups are homogenous and no statistical significance is observed with regard to the age distribution in those with artery ligation and those without.**

In both groups, females represent (83.3%) and males represent (16.6%), as in Table II.

| Groups | females | males | Total |
|---|---|---|---|
| Group I : Inferior thyroid artery ligated. | 50(46.3%) | 12(11%) | 62(57.4%) |
| Group II : Inferior thyroid artery not ligated. | 40(37%) | 6(5.6%) | 46(42.6%) |
| Total | 90(83.3%) | 18(16.6% ) | 108(100%) |
| Chi squared value = 0.757 degree of freedom =1 p value = 0.384 | | | |

**Table II: Distribution of males and females patients in each group. There is no significant difference in the composition of both groups with regard to the gender distribution.**

In this study, we selected some complications of subtotal thyroidectomy to be observed according to our believes that they concern in the surgical dissection in this critical anatomical area where all the vital structures were prone to iatrogenic injuries.

Analysis of collected data reveals a high incidence of postoperative hypocalcemia in both groups, followed by recurrent laryngeal nerve injuries and lastly the development of postoperative hematoma, as shown in Table III.

| Types of complications | Inferior thyroid artery ligation | Inferior thyroid artery not ligated | P value* |
|---|---|---|---|
| *Hypocalcemia. | 31(50%) | 22(47.82%) | 0.175 |
| *Unilateral recurrent laryngeal nerve injury. | 8(12.9%) | 4(8.7%) | 0.491 |
| *Bilateral recurrent laryngeal nerve injury. | 2(3.2%) | 0 | 0.327 |
| *Hematoma. | 3(4.83%) | 1(2.17%) | 0.696 |
| Total | 44(70.96 %) | 27(58.69%) | 0.140 |
| * For Chi square or Fisher's exact tests. | | | |

**Table III: The percentage of patients with postoperative complications.**

The specific complications namely hypocalcemia, nerve injury and hematoma have no statistically significant difference among the two groups. Recurrent laryngeal nerve injuries were observed in fourteen

patients of both groups, ten of them in group I. Bilateral nerve injury were found in two patients of group I, and they required immediate reintubation and postoperative tracheostomy followed by intensive care unit admission for monitoring, and the remaining eight patients have a unilateral injuries which diagnosed by vocal cord examination postoperatively and also confirmed by the development of hoarseness of voice in all of them in the first week postoperatively.

In the seventh postoperative day reevaluation of these patients reveals no any improvement. After three months, six patients showed complete improvement without any interference apart from our advice to them to rest their voice as much as possible. Four patients develops permanent nerve injuries when examined six months later, and they represent (6.5%) of group I patients, as shown in Table (4).

In the second group where the inferior thyroid artery not ligated and no exploration were done to find the recurrent laryngeal nerve, four patients (8.69%) developed temporary nerve injuries which resolved in two patients after a period of six months of their follow up and another two patients stay suffering from hoarseness of voice, as shown in Table IV).

| **Age group** | **Numbers of patients** | | **Third postoperative day** | | **seventh postoperative day** | | **3months** | | **6months** | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Group I | Group II | Group I | Group II | Group I | Group II | Group I | Group II | Group I | Group II |
| **11-20** | 4 | 4 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| **21-30** | 18 | 10 | 3 | 1 | 3 | 1 | 1 | 0 | 1 | 0 |
| **31-40** | 14 | 15 | 2 | - | 2 | 2 | 2 | 2 | 2 | 1 |
| **41-50** | 11 | 11 | 3 | 2 | 3 | 2 | 1 | 1 | 1 | 1 |
| **51-60** | 13 | 5 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 |
| **>60** | 2 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 |
| **Total** | 62 | 46 | 10 | 4 | 10 | 3 | 4 | 3 | 4 | 2 |

**Table IV: Numbers and percentages of patients who developed recurrent laryngeal nerve injuries in both groups**. P value ranges from (0.306) to (0.614) as judged by Fisher's exact test.. There is no significant statistical difference in the time progress.

Transient symptomatic hypocalcaemia was defined as a serum ionized calcium concentration of less than (1.5) mmol/l associated with symptoms that resolved with treatment within (180) days. While permanent hypocalcemia occurs in patients who required continuous treatment lasting longer than (180) days.

The severity of hypocalcemia was assessed by dividing the patients into five grades depending on the levels of serum calcium as the following:-

Grade I : is represented by normal serum level which is ranged between (8.5-10.5) mg%.

Grade II: patients with occasional hypocalcemia.

Grade III: patients with serum calcium less than (8.5 mg%).

Grade IV: the serum calcium is less than (7.5 mg%).

Grade V: in which the serum calcium is less than (6.5mg%). represent the more severe grade, as shown in Table V[16].

| Grade | Details |
|---|---|
| Grade I | No spontaneous hypocalcemia |
| Grade II | Occasional hypocalcemia |
| Grade III | Serum Ca (< 8.5mg %) |
| Grade IV | Serum Ca (< 7.5mg%) |
| Grade V | Serum Ca (< 6.5mg%) |

**Table V: Grades of hypocalcaemia[19].**

According to these grades, we can obviously see the high percentages of postoperative hypocalcemia in both groups, Table VI and Table VII.

The percentage of patients with postoperative hypocalcemia was very high. In general, thirty one patients (50%) in group I developed hypocalcemia. Nine patients (14.51%) developed clinical signs and symptoms of hypocalcaemia, whereas twenty two patients (35.48%) were asymptomatic in spite of biochemical hypocalcemia. One female patient (1.6%) was found to have a serum calcium level below (6.5 mg %) and she developed severe attack of hypocalcaemia that required intravenous calcium supplementation. On the other hand, when symptoms occurred in the early postoperative period, we observed and follow those patients with low or very close to lower normal calcium levels, as shown in Table VI.

Twenty four (38.7%) patients, after three months regain the normal calcemic status. Seven patients (11.29%) required a long term, more than six months, treatment with oral calcium supplementation, as shown in Table VI.

| Grade | Serum calcium (Milligrams/100ml) | Inferior thyroid artery ligated ( group I ). | | Total |
|---|---|---|---|---|
| | | Female | Male | |
| Normal | (8.5-10.5) | 19(30.64%) | 12(19.35%) | 31(50%) |
| Grade III | Less than (8.5) | 16(25.8%) | 6(9.67%) | 22(35.48%) |
| Grade IV | Less than(7.5) | 7(11.29%) | 1(1.6%) | 8(12.9%) |
| Grade V | Less than(6.5) | 1(1.6%) | 0 | 1(1.6%) |
| Total | | 43(69.35%) | 19(30.64%) | 62(100%) |
| *Chi squared test value = 1.89 p value = 0.168 | | | | |

Table VI: The severity of hypocalcemia in patients with inferior thyroid artery ligation according to grading system. There is no remarkable association of hypocalcemia occurrence with a particular age group. Total hypocalcemic patients = grade III + IV + V=31 patients(50%). Asymptomatic hypocalcemic patients=grade III=22 patients (35.48%). Symptomatic patients = grade IV + V = 9 patients (14.51%).

In the other group where inferior thyroid artery not ligated, twenty two patients (47.8%) developed hypocalcemia. In the early postoperative period, the second and third postoperative days, only five (10.86%) patients of this group developed signs and symptoms of hypocalcaemia. All were in the ward, and not discharged yet. They managed succefully, by giving them intravenous (10ml) of (10%) calcium gluconate over a period of (20-30) minutes. Only two patients (4.34%) not responded to this regimen and they found to have a serum calcium less than (6.5 mg%) associated with hypomagnesemia(less than 0.7mmol/L) and dramatic response was happened when received intravenous injection of magnesium(0.2-0.4) mmol/kg every 12 hours as slow intravenous infusion).

In the seventh postoperative day, the time of stitch removal visit, we found that twelve patients (26.08%) returned to normal serum calcium level. Another ten patients (21%) required oral calcium treatment for further period.

Three months later, all patients achieved normal serum calcium level except two patients (4.34%) who required another course of oral calcium treatment. Anyhow, all patients, after six months return to normal calcemic status with a (100%) successful rate of management, as shown in Table VII .

The significant observation in both groups was the rapid improvement of hypocalcemia in all patients who have a normal or near normal serum calcium level, as shown in Table VIII.

| Grade | Serum calcium (Milligrams/100ml) | Inferior thyroid artery not ligated ( group II) . | | Total |
|---|---|---|---|---|
| | | Female | Male | |
| Normal | (8.5-10.5) | 20(43.47%) | 4(8.69%) | 24(52.17%) |
| Grade III | Less than (8.5) | 16(34.78%) | 1(2.17%) | 17(36.95%) |
| Grade IV | Less than(7.5) | 3(6.52%) | 0 | 3(6.52%) |
| Grade V | Less than(6.5) | 1(2.17%) | 1(2.17%) | 2(4.34%) |
| Total | | 40(86.9%) | 6(13.04%) | 46(100%) |
| *Fisher's Exact text = 0.667 | | p value = 0.376 | | |

**Table VII:Severity of hypocalcemia in patients without inferior thyroid artery ligation according to grading system. There is no remarkable association of hypocalcemia occurrence with a particular age group.**Total hypocalcemic patients = grade III + IV + V=22 patients(47.82%). Asymptomatic hypocalcemic patients = grade III =17 patients(36.95%). Symptomatic patients = grade IV + V = 5 patients(10.86%).

| Age group | Numbers of patients | | Third postoperative day | | seventh postoperative day | | 3months | | 6months | |
|---|---|---|---|---|---|---|---|---|---|---|
| | GI | GII | GI | GII | GI | GII | GI | GII | GI | G II |
| 11-20 | 4 | 4 | 3 | 3 | 1 | 1 | 1 | - | 1 | |
| 21-30 | 18 | 10 | 5 | 2 | 5 | 1 | - | - | - | |
| 31-40 | 14 | 15 | 9 | 5 | 2 | 2 | - | 1 | - | - |
| 41-50 | 11 | 11 | 6 | 6 | 6 | 4 | 3 | 1 | 3 | - |
| 51-60 | 13) | 5 | 6) | 5 | 4 | 2 | 3 | - | 2 | - |
| >60 | 2 | 1 | 2 | 1 | 2 | - | 2 | - | 1 | - |
| Total | 62 | 46 | 31 | 22) | 20 | 10 | 9 | 2 | 7 | - |

**Table VIII: Numbers and percentages of patients who developed postoperative hypocalcemia in both groups.**

the recovery from hypocalcaemia is not statistically different in both ligated and not ligated inferior artery groups with a P value ranging from (0.076) to (0.869), (applied t-test).

The incidence of postoperative hematoma was (3.7%) in both groups, in three patients (4.84%) of group I and in one patients (2.17%) of group II. In group I, within the first twelve hours postoperatively, a swelling at the wound site were noticed in one patient(1.6%) only and immediate stitches removal in the ward and wound exploration was done in the theatre. Wound healing was completed with no other complications, as shown in Table IX.

| Age group | Patients with inferior thyroid artery ligation | | Patients without inferior thyroid artery ligation | | Total (No=108) |
|---|---|---|---|---|---|
| | Females | Males | Females | Males | |
| 11-20 | 0 | 0 | 0 | 0 | 0 |
| 21-30 | 0 | 0 | 0 | 0 | 0 |
| 31-40 | 1(1.6%) | 0 | 1(2.17%) | 0 | 2(1.85%) |
| 41-50 | 1(1.6%) | 0 | 0 | 0 | 1(0.93%) |
| 51-60 | 0 | 1(1.6%) | 0 | 0 | 1(0.93%) |
| >60 | 0 | 0 | 0 | 0 | 0 |
| Total | 2(3.22%) | 1(1.6%) | 1(2.17%) | 0 | 4(3.71%) |

**Table IX: Numbers and percentages of patients who developed a postoperative wound hematoma in both groups.**

## Discussion

Subtotal thyroidectomy is a very good therapeutic option for patients with diffuse multinodular goiter (simple or toxic). It is a safe and fast method with very low mortality and excellent results. The main complications of this operation are related to the recurrent and superior laryngeal nerves, inferior thyroid artery and the parathyroid glands. When subtotal thyroidectomy is performed by an experienced surgeon, the incidence of these complications is very low[17,18].

Most authors believe that the hypofunction of parathyroid glands occurs because of ischemia, secondary to ligation of the inferior thyroid artery. This is a logical inference, since we know that the blood supply to these glands comes mainly from this vessel[19].

Many papers recommend not to ligate the inferior thyroid artery. The ligation should be made as distal as possible, near the capsule of the thyroid gland[20-24]. On the other hand, some authors recommend ligating the inferior thyroid artery, arguing that the risks of more intra-operative bleeding and damage to the recurrent laryngeal nerve are higher, and the benefits are theoretical and not proven[21].

The most frequent complication in this study is the postoperative hypocalcemia which occurs in noticeably high incidence in both groups. About (50%) in group I and (47.8%) in group II. This result may be attributed, in both groups, to:-

1-Accidental devascularization of one or

several parathyroid glands.
2-Infarction during manipulation.
3-Inadvertent removal of the parathyroids with the thyroid lobes.
4-Release of Calcitonin due to manipulation during surgery[22]. Nies et al and Kovacs and his colleagues observed that transient mild hypocalcaemia may not be due to parathyroid insufficiency[23]. It can also be observed after other operations accompanied by blood loss or development of hypoalbuminaemia. They are of the opinion that fluid shifts and dilutional effects can cause temporary hypoalbuminaemia; calcium binding capacity is thereby reduced causing a decrease in total serum concentration. Ionized calcium levels are not influenced by this effect. It may also be a cause of the asymptomatic hypocalcaemia in the immediate postoperative period[23].

In those with inferior thyroid artery ligation the incidence of hypocalcemia was (50%) in the third postoperative day which reduced to (32.2%) at the end of the first postoperative week and they required prolong treatment with oral calcium and vitamin D supplementation for further three months. (14.5%) were still hypocalcemic after three months and required continuation of calcium treatment for another three months. Permanent hypocalcemia was developed in (11.2%) only.

In those without inferior artery ligation, the incidence of hypocalcemia was also relatively high and represent about (47.8%) when assessed on the third postoperative day, with reduction to (21%) at the end of the first postoperative week in whom oral calcium and vitamin D supplementation were given to correct this deficiencies. After a period of three months, (4.4%) only required further medical treatment. within the period of the last three months of follow up, all cases of hypocalcemia were resolved.

Fortunately, majority of hypocalcemias were transient, asymptomatic and resolved without treatment within the first week postoperatively, as shown in Table (10). Symptomatic hypocalcemia was found in about (14.51%) of group I patients and in (10.86%) of group II patients.

Iqbal J et al, they stress on adherence to strict capsular dissection during surgery[22]. They noticed that patients undergoing subtotal thyroidectomy developed asymptomatic hypocalcaemia in (18.8%), and transient symptomatic hypocalcemia needing calcium supplements in (5.45% ) of the patients[21]. Halsted and Evans in 1907 first time concluded from anatomical studies that to preserve parathyroid circulation, inferior thyroid artery should not be ligated during thyroid surgery[1].

Thomusch et al, recommended that ligation of inferior thyroid artery at thyroid capsule is a better technique and having less incidence of hypocalcemia[29]. Statistically, there is no significant difference regarding postoperative hypocalcaemia between truncal ligation and non-ligation of inferior thyroid arteries in both groups.The high incidence of postoperative hypocalcemia in both groups are similar to that reported by others[29].

Ligation of the inferior thyroid artery was apparently not the cause of the hypocalcemia, since there was no difference between the two groups. This was the same conclusion of Drezner et al. ,Cakmakli et al,Kalliomaki et al, and Nies et al[22-25]. Only seven patients in group I became definitively hypocalcemic, but this occurrence was not statistically significant.

Regarding the hypothesis of devascularization of parathyroid glands, there is such a rich anastomotic network of the capillaries in the neck that if the arterial supply of the parathyroid glands is even compromised, still these should

regenerate and revascularize in the much natural way as opposed to the auto-transplanted glands when accidentally or willingly removed[25].

Recurrent laryngeal nerve injury is either unilateral or bilateral, temporary or permanent. In group I, nerve injuries were occurred in about (16%) of the patients. Temporary recurrent nerve injuries were in about (60%) of all those with nerve injuries and the other (40%) were failed to regain the preoperative voice quality i.e. (6.4%) of patients of this group developed permanent nerve injuries. In two patients (3.2%) of the group I, bilateral nerve injuries were observed immediately postoperatively and it considered as a cause behind their permanent nerve disability.

In the second group, the nerve injuries were occurred in a percentages of (8.7%) but there was no bilateral nerve injuries.

Deliberate identification of the recurrent laryngeal nerve minimizes the risk of injury. When the nerve is identified and dissected, the reported recurrent laryngeal nerve injury rate during thyroidectomy is (0-2.1%). This rate is reportedly higher if surgery is repeated (2-12%) or if the nerve is not clearly identified (4-6.6%). Intraoperative hemostasis and a thorough understanding of the anatomy are essential for identifying and preserving the nerve.

Several approaches are used to identify and preserve the recurrent laryngeal nerve. This approach of nerve identification in our locality are not possible due to absence of facilities.

postthyroidectomy hematoma, though rare, is more serious and it can be fatal. The reported incidence of post-thyroidectomy hematoma varies between 0.1-1.1%[26].

Postoperative bleeding will characteristically be prefaced by respiratory distress, pain, or cervical pressure, dysphagia, and increased blood drainage.

No specific perioperative risk factors that would allow identification of the high-risk patient population for this potentially lethal complication are known. Consequently, the key issue of prevention is attention to anatomic detail and careful hemostasis during surgery[27].

The incidence of hematoma formation in both groups( 3.7%) was higher than those reported by the others[25-27] and this can be attributed to the small sample size of each group, the emergence of hematoma in sporadic cases and the exclusive affection of female in group (II). Statistically, these problems makes the calculations of chi square and p value are inapplicable.

Shaha et al, reported the experience of (600) thyroidectomies with (8) patients developing wound hematoma (1.3%). The diagnosis was made within (2-6) hours after surgery. All patients except one were re-explored. There was no urgent need to perform tracheostomy on any of these patients.

Considerable oedema of the epiglottis and pharyngeal wall was noted during intubation. The author suggested not to close the strap muscles very tightly so that any hematoma which develops can become apparent in the subcutaneous region[27].

Lacoste et al, reported (0.36%) incidence of postoperative hematoma in a series of (3008) thyroid surgeries. In view of the authors, tracheal intubation is of paramount importance in case of an acute asphyxia and reopening of the surgical wound is rarely indicated to make the tracheal intubation easier[28].

Certain precautions have been suggested to prevent post-thyroidectomy hemorrhage and hematoma formation and these are[28]:-

a. Meticulous hemostasis.

b. The patient should be placed in a 30° head down position prior to wound closure to look for any venous bleeding.

c. Leaving the gap in the lower end,

while suturing the strap muscles in the midline, so as to allow the blood to come out of the relatively closed compartment into the sub-platysmal space where it can be easily detected. d. Avoidance of coughing at extubation. Smooth extubation should be the goal of good anaesthesia.

Post-thyroidectomy hematoma, though rare, is most serious amongst other complications, as it can be fatal. However, this can be efficiently managed by meticulous attention to hemostasis, careful monitoring in the recovery room, appreciation of subtle signs of respiratory distress, early airway and surgical intervention and finally by following the dictum that every case of thyroidectomy is a potential candidate for postoperative hemorrhage. Any delay in detection and intervention can be fatal[28].

## Conclusion

Statistically, there is no significant difference regarding post-operative hypocalcaemia, recurrent laryngeal nerve injury and hematoma formation between truncal ligation and non-ligation of inferior thyroid arteries.

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