Incidence of Post-Operative Hypocalcaemia Post Total Thyroidectomy in the Early Learning Curve of Junior Surgeons

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Abstract: Background: Goiter is one of the most common disorders within the thyroid gland. Some patients are presented with symptoms while other are presented without symptoms and discovered accidentally during a routine U/S of the neck. Goiter is defined as an enlargement of the thyroid gland. **Aim of the Work:** The purpose of this study is to detect the hypocalcaemia rate after total thyroidectomy done by junior surgeons in their early learning curve. **Materials and Methods:** This is a prospective study of new consecutive patients underwent total thyroidectomy and preoperative and postoperative time-serial analysis of total calcium, and PTH levels to study the incidence of hypocalcemia post total thyroidectomy done by junior surgeons in their early learning curve from July 2018 to December 2018 in Ain shams university hospital. Total patients in the study are 20 patients undergoing total thyroidectomy operated by the same surgical team under the supervision of the same university professors. Results: **Conclusion:** By applying this study the junior staff could have a chance to increase their learning curve and dependability in the surgical ward as they are supervised by the professors. Given the statistical analysis the results are nearly the same regarding this study and previous studies.

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1. Introduction

Goiter is one of the most common disorders within the thyroid gland. Some patients are presented with symptoms while other are presented without symptoms and discovered accidentally during a routine U/S of the neck. Goiter is defined as an enlargement of the thyroid gland. This gland may be hyper or hypo functioning. Most of the times the gland is euthyroid. Which means there is no hormonal imbalance **(Gulcelik et al., 2012).**

Nodular goitre is the normal consequence of nontoxic goitre, which may be endemic, sporadic or familiar. Iodine deficiency is the main cause of endemic goitre, The prevalence of nodular goitre is related to the iodine deficiency that is present in several areas of the world. In iodine deficient areas such as some Italian regions, nodular goitre is present in 25-33% of the population, its frequency increasing with age. In iodine sufficient areas the prevalence of nodular goitre is comprised between 0.4 and 7.2% high in iodine deficient areas and about 4% in iodine sufficient countries, its frequency increasing with the age. Dysphagia, dyspnoea and coarsening of the voice may occur for oesophagus, tracheal or laryngeal nerve compression, while, with regard to the histological pattern, it leads to an increased ratio papillary/follicular. Thyroid function is normal in uncomplicated nontoxic goitre. However, the evolution of nodular goitre is toward the functional composition of nodules that may result in thyrotoxicosis. Hypothyroidism is rare and is usually the result of thyroid autoimmunity. All the cases due to iodine deficiency can be prevented by an adequate iodine prophylaxis that can be accomplished in industrialized countries **(Caulley et al., 2017).**

The most commonly used treatment is the total thyroidectomy. In which the whole gland is excised and then sent for a pathology report. Some patients with a dominating nodule is studied with a fine needle aspiration biopsy. The complications of total thyroidectomy varies. Ranging from hypocalcaemia to recurrent laryngeal nerve injury. The most common focus in recent surgical techniques and technologies is to decrease the morbidity and to spare nearby structures related to the thyroid gland. This study is to detect the early hypocalcaemia rate post total thyroidectomy. And to act as a reference to watch for these complication in the post-operative care ward to avoid the morbidity and exacerbation of these complications **(Hussain et al., 2017).**

Aim of the work

The purpose of this study is to detect the hypocalcaemia rate after total thyroidectomy done by junior surgeons in their early learning curve.

2. Materials and Methods

Patient Eligibility and Study Design:

This is a prospective study of new consecutive patients underwent total thyroidectomy and preoperative and postoperative time-serial analysis of total calcium, and PTH levels to study the incidence of hypocalcemia post total thyroidectomy done by junior surgeons in their early learning curve from July 2018 to December 2018 in Ain shams university hospital.

Total patients in the study are 20 patients undergoing total thyroidectomy operated by the same surgical team under the supervision of the same university professors.

Inclusion Criteria:

- Age from 20-60 years old (with higher incidence rate of goitre).
- Both sexes will be included.
- Patients who are candidates for total thyroidectomy including:
  - Malignancy.
  - Suspicious Malignancy.
  - Pressure symptoms.
  - Toxic multi-nodular goitre.
  - Relapsing toxic diffuse goitre.

Exclusion Criteria:

- Patients who are unfit for surgery due to a pre-existing medical condition and according to ASA classification.

All patients had normal lab results at the time of surgery. Patient information regarding age, sex, pathology, operative procedure and presence of symptoms of hypocalcemia were recorded. Informed consent was obtained from all patients.

Patients and methodology

For all patients, the following has been done.

I- Preoperative assessment:

A) Clinically

1-Detailed history: including any history suggestive of hypocalcaemia, pressure symptoms, toxic manifestations.

All patients had normal Lab results at the time of surgery. None of the patients had signs or symptoms indicating metabolic bone disease, and none of the patients were on medications, such as oral calcium / vitamin D supplementation, anti-resorptive agents, hormone replacement therapy for postmenopausal women, anabolic agents, thiazide type diuretics, or antiepileptic agents, known to affect serum calcium metabolism.

2- Physical examination.

General:

Including the pulse, body built, weight and blood pressure, as well as toxic manifestations or manifestations suggestive of distant metastases.

Local:

Inspection, palpation, percussion and auscultation with the aim to determine the following: (Which thyroid lobe is involved, size of the thyroid gland and its consistency, mobility or fixation to the surrounding structures, presence of palpable thrill or audible bruit, presence of retrosternal extension).

B) Indirect laryngoscopy:

This was done to assess the mobility of the vocal cords

C) Radiological assessment:

- Chest x-ray poster anterior view
- Neck ultrasound
- Thyroid scan to detect any toxic nodules

D) Laboratory assessment:

Blood samples were collected using conventional venepuncture for:

1. Routine preoperative assessment.
2. Free T3, T4 and TSH assessment.
3. Total and ionized serum calcium.
4. PTH assay

If the patients were found to be toxic they would have to be prepared before surgery by taking Inderal 40mg daily dose to control the cardiac manifestations of the toxic symptoms. Carbimazole 5 mg was used to regulate the thyroid functions taken 3 times a day and reassessment of the Free T3, T4 and TSH after 1 months. Then reassessment and adjustment of the doses were done to ensure the normal value of the lab results before surgery and also to regulate the functions of the thyroid gland.

II- Operative technique

1. Under general anesthesia, the patient was placed in a supine position with the neck extended. A low collar incision was made and carried down through the subcutaneous tissue and platysma muscle.
2. Superior subplatysmal flap was developed, and the strap muscles were divided vertically in the midline and retracted laterally and dissected from the relevant thyroid lobe.
3. The middle thyroid vein was ligated.
4. The superior pole of the thyroid was dissected free, and care was taken to identify and preserve the external branch of the superior laryngeal nerve. The superior pole vessels were ligated individually very close to the upper pole of the thyroid lobe.
5. The inferior thyroid artery and recurrent laryngeal nerve were identified to preserve blood supply to the parathyroid glands, the inferior thyroid artery was not ligated laterally as a single trunk; rather, its branches were ligated individually on the

capsule of the lobe after they have supplied the parathyroid glands.

6. The parathyroid glands were identified, and an attempt was made to leave each with an adequate blood supply while moving the gland off the thyroid lobe.

7. Care was taken to identify the recurrent laryngeal nerve along its course if a total lobectomy is to be done. The nerve was gently unroofed from surrounding tissue, with care taken to avoid trauma to it. The nerve is in greatest danger near the junction of the trachea with the larynx at the ligament of Berry where it is adjacent to the thyroid gland. Once the nerve and parathyroid glands have been identified and preserved, the thyroid lobe was then removed from its tracheal attachments by dividing the ligament of Berry.

8. The contralateral thyroid lobe was removed in a similar manner.

9. While the isthmus and the pyramidal lobe were dissected and controlled hemostasis was done from the tracheal sheath.

10. Careful hemostasis and visualization of all important anatomic structures were mandatory for success.

11. A small suction drain was inserted through a small stab wound; it was generally removed within 24 hours.

12. The strap muscles sutured vertically. Platysma was closed by interrupted sutures and the skin edges were approximated with a running subcuticular 5-0 absorbable suture.

Postoperative Management:

A) Clinically:

Patients were admitted in the hospital for 2 days after the surgery. During the postoperative period the patients were assessed carefully vital data were recorded 3 times a day for the clinical symptoms and signs of hypocalcaemia (fatigue, weakness, numbness around the lips or the tips of the extremities and positive Chvostek's or Trousseau's signs were considered to be compatible with mild hypocalcaemia while the carpopedal spasm, convulsions and laryngospasm were considered to be associated with advanced hypocalcaemia).

B) Sample Collection and investigations:

Samples for total serum calcium and serum PTH were collected before the operation and labeled as pre-operative sample.

C) Out patient clinic after discharge:

PTH and calcium levels were taken after 1 months and 6 months for follow up to detect the incidence of permanent hypocalcemia.

Statistical analysis

Data were analyzed using Statistical Program for Social Science (SPSS) version 20.0. Quantitative data were expressed as mean. Qualitative data were expressed as frequency and percentage. Probability (P-value): P-value <0.05 was considered significant, p-value <0.001 was considered as highly significant, P-value >0.05 was considered insignificant.

3. Results

Table (1) shows that the female (90%) and male (10%) of gender, the ranged age 29-61 with mean 46.08±7.63.

Table (2) shows statistical significance between hypocalcemic and normocalcemic according to total calcium from after 24 hours.

Table (3) shows statistical significance between hypocalcemic and normocalcemic according to total calcium from after 48h.

Table (4) shows statistical significance between hypocalcemic and normocalcemic according to PTH from after 10min.

Table (1): Demographic data of the studied patients

Demographic Data	No.	%
Gender		
Female	18	90
Male	2	10
Total	20	100
Age (years)		
Range	29-61	
Mean±SD	46.08±7.63	

Table (2): Comparison between patients with and without hypocalcemia according to total calcium (mg/dL).

Total Calcium (mg/dL)	Hypocalcemic (N=5)	Normocalcemic (N=15)	t-test	p-value
Pre-Operative	9.38±0.32	9.58±0.52	1.081	0.305
After 24h	6.76±0.38	8.96±0.40	197.072	<0.001

Table (3): Comparison between patients with and without hypocalcemia according to total calcium (mg/dL).

Total Calcium (mg/dL)	Hypocalcemic (N=5)	Normocalcemic (N=15)	t-test	p-value
Pre-Operative	9.38±0.32	9.58±0.52	1.081	0.305
After 10min	9.20±0.35	9.35±0.49	0.689	0.412
After 48h	6.76±0.38	8.96±0.40	197.072	<0.001

Table (4): Comparison between patients with and without hypocalcemia according PTH.

PTH (pg/ml)	Hypocalcemic (N=5)	Normocalcemic (N=15)	t-test	p-value
Pre-Operative	50.13±1.36	48.09±4.95	1.300	0.261
After 10min	23.00±7.46	44.44±5.85	76.981	<0.001

4. Discussion

Thyroidectomy can cause hypoparathyroidism from removal of parathyroid glands or damage to their blood supply specially when done by junior surgeons in their early learning curve. This is the most frequent postoperative complication, and the subsequent onset of hypocalcemia can pose severe problems **(Alía et al., 2007).**

Post-thyroidectomy hypocalcemia is a major contributing factor in delayed hospital discharge and dissuading surgeons from ambulatory thyroidectomy. In addition, because potentially life threatening hypocalcemia may not develop until 24–48 h after surgery besides postoperative bleeding and hematoma formation, hypoparathyroidism is a major reason for delayed hospital discharge **(Lang et al., 2012).**

Postoperative transient hypoparathyroidism leading to hypocalcemia is the one of the most frequent morbidities following total thyroidectomy, with incidence ranging between 3% and 40% **(Lang et al. 2012)** in comparison to our study with incidence of Postoperative transient hypoparathyroidism about 40 %.

Although the development of hypocalcemia is multifactorial, clinically significant hypocalcemia after thyroid surgery occurs secondary to impairment of parathyroid function in most cases. Postoperative hypocalcemia is usually transient, and the incidence of permanent hypoparathyroidism is 2% or less in most surgical units with experience in total thyroidectomy **(Roh et al. (2006)**. In comparison to our study, 25% of the cases out of 20 manifested transient hypocalcaemia with no detected cases of permanent hypocalcaemia.

Although it is self-limiting in most patients, postoperative hypocalcemia is of particular concern because of a delay in the manifestation and a consequent prolonged hospitalization or readmission. Therefore, efforts have been made to predict which patients are susceptible to the development of this complication and will require supplementation of oral calcium and/or vitamin D **(Roh et al., 2006).**

Because of a search for earlier predictors, the short half-life of PTH has led to increased interest in intraoperative PTH monitoring as an early marker of hypocalcemia **(Alía et al., 2007).**

Given that patients who undergo this kind of surgery are usually discharged early (most often the day after surgery, unless complications occur) reliable markers allowing early diagnosis of hypocalcemia have been thoroughly sought **(Alía et al., 2007).**

Close monitoring of early serum calcium levels is commonly used to identify postoperative hypocalcemia. However, multiple blood samplings to at least the morning after surgery need to be done and early prediction of postoperative hypocalcemia within the same day of operation is impossible. Because serum parathyroid hormone (PTH) is known to be a more useful predictor of impending postoperative hypocalcemia, rapid PTH assay has been used to measure intraoperative PTH levels **(Roh et al., 2006).**

This study can assess perioperative PTH measures as very early predictors of hypocalcemia after treatment to attempt making this kind of surgery an ambulatory procedure in our hospital and our staff consisting of junior surgeons supervised by surgery professors so that patients can be discharged the day of surgery provided that no other risks exist.

In our study, 10 to 15 minutes parathyroid hormone measurement after thyroidectomy can be used as a predictor of hypocalcaemia with accuracy 96%, thus limiting unnecessary calcium supplementation and facilitate early hospital discharge.

However, we assure that our study results can strengthen the applicability of rapid ioPTH assay in

thyroid surgery and suggest a guide that can contribute to managing post-thyroidectomy patients.

Also the capability of junior surgeons in our staff to perform surgeries under the supervision of our professors to increase the learning curve and dependability of our junior staff.

In **Lang et al.** clinical setting, a single quick PTH level measurement taken at the time of skin closure (PTH-SC) while the patient is still anesthetized would be preferred because no extra pain is inflicted while drawing blood and the PTH result would be available sooner to facilitate ambulatory surgery.

This study can evaluate prospectively the accuracy and reliability of quick PTH-SC in predicting clinically relevant postoperative hypocalcemia.

The results of **Noordzij** study demonstrated and confirmed the usefulness of the PTH assay in thyroid surgery. A single PTH threshold (65% decrease compared with a preoperative level) checked 6 hours after completing thyroidectomy has a sensitivity of 96.4% and specificity of 91.4% in detecting postoperative hypocalcemia **(Noordzij et al., 2007).**

A prospective study of 30 patients undergoing total thyroidectomy measured intra operative PTH levels following skin closure, and ionized calcium levels 6 hours and 24 hours postoperatively. An intraoperative PTH level below 10pg/mL had 80% sensitivity, 100% specificity, a 100% positive predictive value, and a 91% negative predictive value for development of symptomatic hypocalcaemia. Patients with such low IOPTH levels should be started on early calcium and vitamin D supplementation **(Richards et al., 2003).**

For our study, cut off value of parathyroid hormone 23 ng/dl can be used as a value to allow for early discharge after appropriate observation for other complications. So, for patients with less than 49 % decrease of parathyroid hormone have a low risk of hypocalcemia and could be discharged after appropriate observation for other complications. These patients should still be educated about symptoms of hypocalcemia and instructed to return immediately if these occur. Despite the overall excellent accuracy of PTH in predicting hypocalcemia after thyroidectomy, false positives and negatives still occur.

For **Roh et al.** study PTH levels were measured at 1 hour or later after the surgery for more confident prediction of postoperative hypocalcemia in several studies. However, other studies have advocated that ioPTH levels obtained immediately after thyroid dissection could be used reliably to predict postoperative hypocalcemia. In addition, it was suggested that a low ioPTH level (<10 pg/mL) may be indicator of vascular injury of an intact gland and may be a guide to more aggressive assessment of the vascularity in the parathyroid glands, and devascularized glands should be considered for autotransplantation **(Roh et al., 2006).**

Sywak et al. study also showed that the ioPTH levels were significantly correlated with standard PTH levels measured 10 min and 48hours after thyroidectomy. However, there was no significant correlation between ioPTH value and iCa level until the morning after surgery. This may be due to a delay in the decline of serum calcium level (to at least 8 hours after the surgery) **(Sywak et al., 2007).**

According to **Sywak** protocol, most of the patients are suitable for discharge within 23 h of surgery. It is likely that those of the hypocalcaemic group may avoid a lengthier than usual hospitalization because of the timely initiation of treatment. This approach has the potential to streamline length of stay **(Sywak et al., 2007).**

For our study cut-off point of parathyroid hormone 10 minutes after thyroidectomy of 23 ng/L as the best compromise between sensitivity and specificity for predicting hypocalcaemia. For patients who have a PTH concentration of greater than 23 ng/ L, discharge is planned at 24 h after surgery. Patients who have PTH concentration less than 23 ng/ L are observed for a further day and timely initiation of treatment is recommended.

The results taken from our study also show that there is no significant difference in the results done by our team than other studies conducted in the past with nearly the same predictive values of the patients outcomes regarding the post operative hypocalcemia. The staff was supervised pre-operatively, intraoperatively and post-operatively by professors of general surgery.

Conclusion

By applying this study the junior staff could have a chance to increase their learning curve and dependability in the surgical ward as they are supervised by the professors. Given the statistical analysis the results are nearly the same regarding this study and previous studies. As it is shown that 25% of the patients in our study had transient hypocalcemia while no permanent hypoparathyroidism are detected in our study.

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