



The role of early postoperative parathyroid hormone level after total thyroidectomy in prediction of hypocalcemia

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ABSTRACT

Background: Estimation of parathyroid hormone (PTH) after thyroid surgery helps to predict the development of hypocalcemia and allows early intervention and management with oral calcium and/or vitamin D supplementation in the postoperative period.

Patients and methods: This retrospective study included 57 patients who underwent total or completion thyroidectomy within 4 years. Measurement of serum PTH level was done 3 h after surgery for its change and prediction of hypocalcemia.

Results: The mean age was 42.11 years, females constituted 46 patients (80.7%), the main surgical procedure was total thyroidectomy in 51 patients (89.5%), and the main cause for surgery was multinodular goiter in 33 patients (57.8%). Three hours after surgery 47 patients (82.5%) had serum PTH levels of >10 pg/ml (mean 28.06) and 44 patients (77.2%) had normal serum calcium (mean 8.66). Most of these 47 patients (82.46%) didn't require postoperative supplementation, while from other 10 patients (17.5%) with serum PTH level of <10 pg/ml, 7 patients (12.28%) required both oral calcium and vitamin D, and 3 patients (5.26%) required only oral vitamin D. There was a significant correlation between the 3-h postoperative PTH level and hypocalcemia (P-value 0.000). The type of pathology had no significant association with lowserum PTH level after surgery (P-value 0.166).

Conclusion: PTH measurements at 3 h after total thyroidectomy is an accurate predictor for the development of hypocalcemia and allows starting early calcium and/or vitamin D supplements for the asymptomatic patients with PTH level of less than 10 pg/ml, which is considered a high-risk group. Also it facilitates a safe and early (2ndnd day post operative) discharge of those patients with serum PTH levels greater than 10 pg/ml without any supplements.

Further studies are needed to compare the result of early serum PTH level with the day one serum PTH level after total thyroidectomy to predict hypocalcemia.

1. Introduction

The optimal management for patients with hypocalcemia after thyroid surgery is still a matter of great debate and there are many proposed postoperative management protocols to achieve the best management plan and decrease the rate of postoperative hypocalcemia after surgery. Symptomatic parathyroid dysfunction is a common complication after total or completion thyroidectomy and it may be associated with significant patient morbidity after surgery and may increase the duration of hospital stay and readmission rates [1,2].

The parathyroid glands may be inadvertently or deliberately injured or removed with the thyroid gland during surgery, transient ischemia or frank infarction of the gland may also result in parathyroid dysfunction

and when this is discovered intraoperatively the gland may be auto-transplanted to the neck or arm skeletal muscles and marked with either a metallic clip or non-absorbable suture material for future follow up. Iatrogenic injury to the parathyroid gland is detected by measuring the parathyroid hormone (PTH) level after surgery [1].

Intact PTH is an 84-amino acid protein released from the parathyroid glands and its secretin is largely affected by the level of the ionized serum calcium level under direct feedback mechanism from extracellular calcium ions, this release is mediated by calcium receptors on the surface of parathyrocytes. The half-life of the PH is measured in minutes and can be readily assessed in the serum [3].

PTH is degraded into several small proteins which have variable half-lives and biological activities. The development of clinically detectable

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hypocalcemia may be delayed for up to 48 h after the development of hypoparathyroidism depending on the degree of biological activity of the PTH particles, the level of the serum vitamin D, the electrolytes status, and the presence or absence of bone mineral disorders [1].

As there is a lag between the development of hypoparathyroidism and the appearance of symptomatic hypocalcemia, early supplementation with calcium and/or vitamin D can greatly maintain the high-risk patients asymptomatic and preventing the development of symptomatic hypocalcemia with its associated morbidity [1].

Some studies recommend the routine estimation of parathyroid hormone levels after thyroid surgery which will help greatly to predict the development of hypocalcemia, early intervention and management will avoid or at least will reduce the development of such complications and result in early postoperative discharge. Routine usage of oral calcium and/or vitamin D supplementation has been similarly shown to reduce its incidence [4–7].

This study aims to evaluate the role of early postoperative estimation of parathyroid hormone in predicting the development of post total thyroidectomy hypocalcemia and managing patients with oral supplementation of calcium and vitamin D to reduce the significant clinical hypocalcemia.

2. Patients and methods

This study is registered, ethically and scientifically by the scientific committee in the Duhok College of Medicine, registration number: 3 N on 26th of November 2020.

In accordance to the World Medical Association's Declaration of Helsinki 2013, the work of this article is registered in the Research Registry and the unique identification number (UIN) is: 6585.

This is a retrospective study that included 57 patients who underwent total or completion thyroidectomy under general anesthesia in a single surgical center. The operations were done by a single surgeon who is experienced in the field of general surgery.

Cases were selected in the period from January 2015 to September 2018, from Duhok governorate, Kurdistan Region/Iraq. A venous sample was sent for the evaluation of the PTH level 3 h after surgery. PTH level estimation was done in hospital laboratory by in vitro quantitative determination using the Cobas system®. The test results usually ready 1 h after taking the blood sample.

Serum PTH levels between 10 and 55 pg/ml were used as a normal level. Its level below 10 pg/ml were regarded reduced. Serum calcium levels between 8.5 and 10.5 mg/dl were considered normal, hypocalcemia were defined by serum calcium equal or lower than 8.4 mg/dl.

Patients who were less than 18 years, those who underwent lobectomy or less than total thyroidectomy, and those who refused to be included in the study, were excluded.

3. Results

The mean age of the patients who were involved in our study was 42.11 years, females constituted 46 patients (80.7%), the main surgical procedure was total thyroidectomy, and the main cause for surgery was a multinodular goiter. Table 1.

In 47 patients (82.5%) the PTH level was greater than 10 pg/ml after surgery with a mean level of 28.06, and 44 patients (77.2%) have normal serum calcium level after surgery with a mean level of 8.66. Table 2.

Forty-seven patients (82.5%) with serum PTH levels of more than 10 pg/ml didn't require any postoperative supplementation after surgery, while other 10 patients (17.57%) with serum PTH level of less than 10 pg/ml required some forms of supplementation; 7 (12.28%) of them required both oral calcium and vitamin D supplements, and 3 (5.26%) of them required only oral vitamin D supplementation. Fig. 1.

There were significant correlations between the 3 h postoperative serum PTH levels and the 24 h postoperative serum calcium while there

Table 1

Showing the characteristics of the patients who are involved in our study.

Category (n = 57)	Number of patients	Percentage
Age (M; SD)	42.11	10.859
Range: 21-70		
Gender		
Male	11	19.3
Female	46	80.7
Surgical procedure		
Total thyroidectomy	51	89.5
Completion thyroidectomy	6	10.5
Diagnosis		
MNG	22	38.6
PTC	11	19.3
Toxic MNG	8	14.0
Thyroiditis	6	10.5
Graves' disease	5	8.8
Recurrent MNG	3	5.3
Follicular carcinoma	1	1.8
Anaplastic thyroid cancer	1	1.8

Abbreviations: MNG: multinodular goiter, PTC: papillary thyroid cancer.

Table 2

Showing the postoperative serum levels of the parathyroid hormone and the calcium.

Categories	Number of patients	Percentage
Serum PTH 3 h after surgery		
Normal (10–55 pg/ml)	47	82.46
Reduced (<10 pg/ml)	10	17.54
Serum calcium 24 h after surgery		
Normal (8.5–10.5 mg/dl)	44	77.2
Reduced (<8.4 mg/dl)	13	22.8

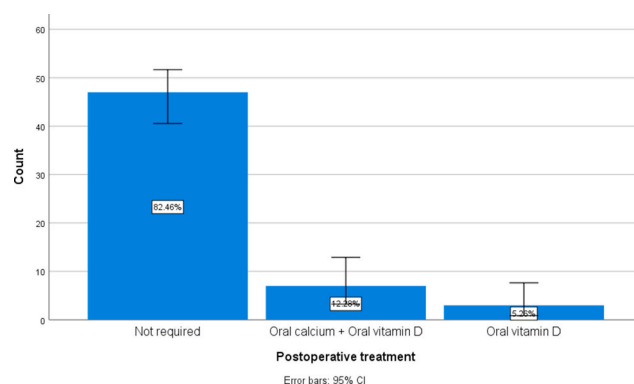


Fig. 1. A simple bar chart showing the percentages of patients who required postoperative supplementation with oral calcium and/or vitamin D.

are no significant correlation with the type of the pathology, the gender and the type of the surgical procedure. Table 3.

4. Discussion

Vitamin D is a fat-soluble vitamin that has a great effect on the level of serum calcium level, its pharmacokinetics to increase serum calcium level may take up to 48 h. Early identification of high-risk patients with hypoparathyroidism and hypocalcemia after thyroid surgery is very important to allow early supplementation with calcitriol, the PTH is checked 3 h after surgery and the serum calcium is checked 24 h after surgery [1].

Normal PTH level is estimated to range between 10 and 55 pg/ml. In the current study, the mean level of PTH of our patients was 28.06 pg/ml, and the reported percentage of patients having low PTH levels 3 h after surgery was 17.54%. Parathyroid dysfunction after thyroidectomy

Table 3

Showing the correlation between the serum PTH 3 h after surgery and different patient characteristics.

Variables	Serum PTH 3 h after surgery		Sig. (2-sided)
	Normal (n = 47)	Reduced (n = 10)	
Gender			0.059*
Male	7 (14.9%)	6 (40%)	
Female	40 (85.1%)	4 (60%)	
Surgical procedure			0.237*
Total thyroidectomy	43 (91.5%)	8 (80%)	
Completion thyroidectomy	4 (8.5%)	2 (20%)	
Serum calcium 24 h after surgery			0.000*
Normal	41 (93.2%)	0 (0.0%)	
Reduced	3 (6.8%)	13 (100.0%)	
Diagnosis			0.166*
MNG	21 (43.8%)	1 (11.1%)	
Recurrent MNG	3 (6.3%)	0 (0.0%)	
Toxic MNG	6 (12.6%)	2 (22.2%)	
Graves' disease	4 (8.3%)	1 (11.1%)	
PTC	8 (16.7%)	3 (33.3%)	
Anaplastic thyroid cancer	0 (0.0%)	1 (11.1%)	
Thyroiditis	5 (10.4%)	1 (11.1%)	

*Fischer Exact test.

may be transient or permanent, studies concluded that transient hypoparathyroidism may be detected in up to 65% of the patients after total or completion thyroidectomy, while the rate of permanent dysfunction may reach up to 3–5%. The role of intraoperative measurement of PH is not superior to the postoperative PTH assay. Many of the published articles recommend the use of 3 h post thyroidectomy estimation of PTH, because its level will be significantly reduced after 3 h [1,8,9].

The type of the pathology has been shown to have no significant association with the development of low serum PTH after surgery (P-value 0.166), this may be attributed to that the surgical procedure is principally the same. Cases with thyroid cancer usually require more extensive dissection and may be some associated with a higher incidence of parathyroid injury [6,10,11].

Hypocalcemia is defined as serum calcium levels lower than 8.5 mg/dl, the mean level of serum calcium of our patients was 8.695 mg/dl and we reported that 13 patients (22.8%) were diagnosed with hypocalcemia. Studies had reported that hypocalcemia is the most common complication after total thyroidectomy and they reported a rate reaching up to 25% after surgery by 24 h, according this we reported a relatively lower rate of hypocalcemia when compared with similar articles, but the number of our cases is not very large [1,12].

There was a significant correlation between the 3 h postoperative PTH level and the development of hypocalcemia 24 h after surgery (P-value 0.000), single measurements of the PTH levels after surgery can predict the development of hypocalcemia and the early supplementation of calcium and vitamin D will prevent the development of clinically significant hypocalcemia and may subsequently reduce the readmission rates. Some authors recommend serial measurement of PTH within 18 h after thyroidectomy [13–15].

Although the low levels of PTH after surgery have been proved to be associated with symptomatic hypocalcemia, authors recommend that more studies are still required to define the cut off level of the PTH which indicate medical treatment with either or both calcium supplementation and vitamin D. Other authors concluded that PTH may not be the only determinant for the development of hypocalcemia and other possible factors may play a major role like minerals, dietary habits, and other metabolic disorders [16–18].

5. Conclusion

PTH measurements at 3 h after total thyroidectomy operation is an accurate predictor of hypocalcemia and allows starting early calcium

and Vitamin D supplements for the asymptotic patients with PTH level of less than 10 pg/ml, that considered a high-risk group for the development of hypocalcemia.

Also, it facilitates a safe and early (2nd day postoperative) discharge of those patients with PTH levels of more than 10 pg/ml, without any unnecessary calcium supplements. Further studies are needed to compare the result of early serum PTH level with day one serum PTH level after total thyroidectomy to predict hypocalcemia.

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Author contribution

Study design, data collection and analysis, writing and final approval of the manuscript: Abdullah Saeed Abdullah.

Guarantor

Dr Abdullah Saeed Abdullah.

Declaration of competing interest

No conflicts of interest present.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.amsu.2021.102252>.

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