

A Scoring System for Early Prediction of Hypocalcemia after Total Thyroidectomy

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ABSTRACT

Background: Postoperative hypocalcemia is a common and most often transient event after extensive thyroid surgery. It is important to predict which patient is likely to develop clinically significant hypocalcemia so that an early treatment can be initiated for these patients.

Objective: To look at combination of certain factors in order to establish a scoring system, which will enable us to predict the occurrence of post total thyroidectomy clinically significant hypocalcemia, which in turn will enable us to discharge the patient within 24 hours after surgery.

Methods: This prospective study was carried out on 81 patients who had underwent total thyroidectomy at the surgical units of Baghdad teaching hospital during a total period of 14 months. Pre-operative serum calcium, vitamin D levels, post-operative serum calcium, intact Para thyroid hormone (iPTH) levels, presence of hyperthyroidism, advanced age of the patient, parathyroid preservation, and size of goiter at surgery had all been studied and analyzed in correlation with the development of post total thyroidectomy hypocalcemia.

Results: There is a significant association between the age of the patient, presence of hyperthyroidism, postoperative serum calcium and PTH values, the number of the preserved parathyroid glands and size of the thyroid nodule and development of hypocalcemia.

Conclusions: A scoring system based on several parameters looks to be a good tool to predict the risk of hypocalcemia post total thyroidectomy and guide the decision to discharge the patient or not.

Keywords: Hypocalcemia, Post-thyroidectomy, Total thyroidectomy, Scoring system.

Iraqi Medical Journal Vol. 67, No. 1, Jan-June 2021; p. 14-19.

Postoperative hypocalcemia is a common and most often transient event after extensive thyroid surgery⁽¹⁾. It is important to predict which patient is likely to develop clinically significant hypocalcemia so that an early treatment can be initiated for these patients⁽²⁾.

Preoperative serum vitamin D level, pre-operative serum calcium, post-operative serum calcium, post-operative intact para thyroid hormone (iPTH), presence of hyperthyroidism, advanced age of the patient, parathyroid preservation, and size of goiter at surgery have all been implicated in the development of post total thyroidectomy hypocalcemia⁽²⁾.

Postoperative hypocalcemia cannot only cause clinical symptoms but can also become a major contributing factor of prolonged hospitalization, for close observation and frequent laboratory evaluations⁽³⁾.

Hypocalcemia can be asymptomatic, particularly if calcium levels are only mildly reduced, or symptomatic with typical manifestations such as Chvostek's and Trousseau's signs, muscle spasms and paresthesia. Severe neurological manifestations may occur if the condition is not adequately treated⁽⁴⁾. So early detection of hypocalcemia is crucial.

This study was conducted to look at all of these factors and to develop a scoring system using a combination of these factors. This will enable us to predict occurrence of post total thyroidectomy

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clinically significant hypocalcemia, which in turn will enable us to discharge the patient within 24 hours after surgery.

Methods

A prospective randomized study included 81 patients who underwent total thyroidectomy, operated on from 1st of October 2017 to 30th of November 2018, in the surgical units at Baghdad Teaching Hospital in medical city, all patients subjected to elective surgery for benign multinodular goiter and early thyroid carcinoma. Advanced thyroid carcinomas

that need neck dissection were excluded from the study. This scoring system was based on multiple parameters, with score from zero to eight. The key aspects of the score include; patient's age, pre-operative serum calcium level, presence of hyperthyroidism, pre-operative serum vitamin D level, postoperative parathyroid hormones level after 8 hours (done at a private outside lab in most of the cases), postoperative serum calcium level after 12 hours, number of parathyroid glands preserved during operation, thyroid lobe size that is removed during operation, (Table 1).

Table 1: Scoring system

Parameters	Yes	No
Age of patient \geq 60 years	1	0
preoperative serum calcium $<$ 8mg/dl	1	0
Presence of hyperthyroidism	1	0
Preoperative serum vitamin D level $<$ 20 ng/ml	1	0
Parathyroid hormones after 8 hours $<$ 10 pg/ml	1	0
Post-operative serum calcium after 12 hrs $<$ 7.5 mg/dl	1	0
Number of parathyroid preserved \leq 2	1	0
Size of thyroid nodule \geq 4 cm	1	0
Total score	8	

So the maximum score level is 8 and the minimum score is zero, with this scoring system, a score of 4 or less, there is low risk of developing significant clinical hypocalcemia, a score of more than 4 will consider a high risk of developing clinically significant hypocalcemia. All patients included in this study did not take any prophylactic calcium tablets.

A maximum of 8 points and minimum of 0 points were chosen to each case.

The Statistical Package for Social Science (SPSS) version 22 and Excel program 2013 were used for data entry and analysis. Tables were used to describe the

data and suitable statistical tests were used accordingly. Chi-Square test and Fisher's Exact Probability test were used to test association between dependent and independent variables in addition the independent sample T test was used to analyze the quantitative data.

Results

A total of 81 patients who had subjected to total thyroidectomy were enrolled in the current study, and the gender distribution as follow: the majority of the patients were females 69 (85.2%), while the males represents of 12 (14.8%) of the studied group.

Regarding the age of the patients, it was found that 72 patients (88.9%) were in age group less than 60 years old and only nine patients (11.1%) were within the age group more than 60 years old. A highly significant association was found between age >60 and hypocalcemia, (Table 2).

For the pre-operative s. calcium level, it was found that 12 patients (14.85%) were in group less than 8, and 69 patients (85.2%) were in group > 8 for serum calcium levels. No significant differences were found between two groups of hypocalcemia, (Table 3).

Hyperthyroidism was found only in nine patients (11.1%) of the patients who had subjected to total thyroidectomy, while 72 patients (88.9%) were found without hyperthyroidism, (Table 4). A significant association was found between hyperthyroidism and hypocalcaemia.

Table 5 shows that 78 patients were within level less than 20ng/dl of the pre-operative vitamin D and only 3 patients (3.7%) were with more than 20ng/dl for pre-operative vitamin D. No significant association was found between pre-operative vitamin D value and hypocalcemia.

For the distribution of post-op. iPTH it was found that 63 patients were in group >10 (77.8%) and only 18 patients (22.2%) were in group <10, (Table 6).

As shown in table 7, number of patients with >2 preserved parathyroid glands were found is 69 patients (85.2%) while only 12 patients (14.8%) were with group of ≤ 2 preserved glands.

Moreover, a highly significant association was found between the number of the preserved parathyroid glands of ≤ 2 and those which have hypocalcemia and it was the most important factor.

For the size of thyroid nodule, it was found that majority of the patients which are subjected to total thyroidectomy lie in group of < 4 cm size 61 patients (75.3.0%), while those within the group of ≥ 4 cm size are 20 patients (24.7%). A highly significant association was found between thyroid nodule size of ≥ 4 cm and hypocalcemia, (Table 8).

As for total scoring for prediction of hypocalcemia, it was found that those with score ≥ 4 (high score) were 24 patients (29.6%) and those with score <4 (low score) were 57 patients (70.4%) of the patients that underwent total thyroidectomy, (Table 9).

Table 2: Association between age and hypocalcemia.

Age (year)	Hypocalcemia				Total	P Value
	with		without			
	No.	%	No.	%		
<60	15	18.5	57	70.4	72	<0.001
≥ 60	9	11.1	0	0.0	9	
Total	24		57		81	

Table 3: Pre-operative S. Ca level of the studied group.

Pre-operative S.Ca mg/dl	Hypocalcemia				Total	P Value
	With		Without			
	No.	%	No.	%		
<8	6	7.4	6	7.4	12	0.185
≥ 8	18	22.2	51	63.0	69	
Total	24		57		81	

Table 4: Association between hyperthyroidism and hypocalcemia.

hyperthyroidism	Hypocalcemia				Total	P Value
	with		Without			
	No.	%	No.	%		
Yes	6	7.4	3	3.7	9	0.028
No	18	22.2	54	66.7	72	
Total	24		57		81	

Table 5: Association between Pre-operative vitamin D and hypocalcemia.

Pre-operative vitamin D ng/dl	Hypocalcemia				Total	P Value
	With		Without			
	No.	%	No.	%		
<20ng/dl	24	29.6	54	66.7	78	0.6
≥20ng/dl	0	0.0	3	3.7	3	
Total	24		57		81	

Table 6: Association between post-op. iPTH and hypocalcemia.

Post-operative iPTH Pg/ml	Hypocalcemia				Total	P Value
	With		Without			
	No.	%	No.	%		
<10	15	18.5	3	3.7	18	<0.001
≥10	9	11.1	54	66.7	63	
Total	24		57		81	

Table 7: Association between No. of preserved parathyroid glands and hypocalcemia.

No. of preserved parathyroid glands	Hypocalcemia				Total	P Value
	With		Without			
	No.	%	No.	%		
≤2	12	14.8	0	0.0	12	<0.001
>2	12	14.8	57	66.4	69	
Total	24		57		81	

Table 8: Association between nodule size and hypocalcemia.

Nodule size (cm)	Hypocalcemia				Total	P Value
	With		Without			
	No.	%	No.	%		
<4cm	9	11.1	52	64.2	61	<0.001
≥4cm	15	18.5	5	6.2	20	
Total	24		57		81	

Table 9: Total scoring of the patients.

Total score	Hypocalcemia				total
	No.	%	yes	%	
≥4	6	25	18	75	24
<4	57	100	0	0	57
	63		18		81

Discussion

Rogério Aparecido *et al*⁽⁵⁾ and Erbil Y *et al*⁽⁶⁾ have found that the age is a risk factor for clinical hypoparathyroidism, in the present study the number of patient with age > 60 year were 9 patients, all of them developed a clinically significant hypocalcemia with highly significant p value.

Pre-operative low s. calcium is one of the important risk factors to induce clinical significant hypocalcemia after total thyroidectomy as Yamashita H *et al* show in their study, in our study 12 patients were found to have serum calcium less than 8 mg/dl, 6 patients (7.4%) of them showed a clinical significant hypocalcemia⁽⁷⁾.

Pantazi H *et al* and Erbil Y *et al* have found that hyperthyroidism has significant impact over bone turnover even after euthyroid status is restored, which will cause hypocalcemia after thyroidectomy, our study showed that 6 patient from 9 (7.4%) with hyperthyroidism had developed a clinically significant hypocalcemia with a significant p value^(8,9).

Although Erbil Y *et al* show that low level of serum vitamin D is a risk factor for developing hypocalcemia, our study show no significant correlation between patients with low serum vitamin D level and those who develop a significant hypocalcemia⁽⁶⁾.

Pfleiderer *et al* demonstrated that serum calcium of less than 7.6 mg/dl on day 1 after surgery had a 95% specificity in predicting significant hypocalcemia, our study showed a highly significant relation between this parameter and development of a transient hypocalcemia⁽¹⁰⁾.

Post-operative serum iPTH has been used in several studies to predict post total thyroidectomy hypocalcemia.

Payne *et al* and Lombardi *et al* found that low serum iPTH is an important predictive parameter, our study show a highly significant relation between low serum iPTH and risk of developing hypocalcemia, 18(22.2%) patients had low serum iPTH, 15 (18.5%) patients developed a significant hypocalcemia^(11,12).

Pattou F *et al* and Thomusch O *et al*, have suggested that at least 3 parathyroid glands need to be saved while others think that two functional glands are enough to prevent post total thyroidectomy hypocalcemia^(13,14). In the present study, we found a significant relation between the number of preserved parathyroid glands and risk of hypocalcemia, 12(14.8%) patients with less than two gland preserved, all of them develop a significant hypocalcemia. Those patients with two preserved parathyroid glands but yet had developed hypocalcemia, the condition actually was just transient.

The last parameter used in the score is the size of thyroid nodule that was removed during surgery, Bunyami Ozogul *et al* and PV Pradeep *et al* found that thyroid nodule size of more than 4 cm is a risk factor for developing hypocalcemia^(15,2). Our study also shows a significant relation, 20(24.7%) patients with thyroid nodule of > 4 cm, 15 (18.5%) patients of them developed a clinically significant hypocalcemia. A probable explanation for this issue is that it would be easier to handle and there is a definitely less dissection to be done in dealing with the involved lobe, so there is less chance for injury to the parathyroid glands or its blood supply in the cases of small size nodule.

Over all, the score system that had been discussed in this study based on several parameters that are considered as risk factors for a clinical significant

hypocalcemia after total thyroidectomy, most of these parameters show a high correlation with hypocalcemia. A score that is equal or above 4 show a significant risk of hypocalcemia, 24(24.6%) patients out of 81 having score ≥ 4 , 18 (75%) of them developed a clinically significant hypocalcemia. While patients with score < 4 were 57, no one of them develop a hypocalcemia. So, this scoring system tends to be a useful method for early prediction of hypocalcemia after total thyroidectomy and saves 2 or 3 days of observation before patient discharge. The possible limitations for such scoring system can be the higher number of tests required, which are not done during the routine thyroidectomy (vitamin D, Serum iPTH etc.) and also the concern of additional costs.

In conclusions; A scoring system based on several parameters looks to be a good tool to predict the risk of hypocalcemia post total thyroidectomy, and aid the decision for discharging the patient or not.

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