Determining Factors Associated with Calcium Level Changes after Thyroidectomy

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Abstract:

Background and Objective: Hypocalcemia after thyroidectomy surgery is one of the common and important complications that can lead to serious clinical complications. In this study, factors related to the occurrence of hypocalcemia after thyroidectomy are investigated.

Materials & Methods: The present study was an analytical cross-sectional study that was conducted with the aim of determining the factors related to the occurrence of hypocalcemia after thyroidectomy in Shahid Beheshti Hospital, Qom during 2012-2019. Factors related to hypocalcemia were measured in these patients. Finally, all information was entered into SPSS version 22 software and analyzed with t-test and chi-square statistical tests.

Results: The average age of patients participating in this study was 42.16 ± 11.97 years. 47 patients were male (12.7%) and 322 were female (87.3%). 70 patients (19%) had thyroid malignancy, 28 patients (7.6%) had Hashimoto's disease, 68 patients (18.4%) had Graves' disease, and finally 183 patients (49.6%) had multinodular goiter. The level of Ca after surgery in three stages (Immediately, one and six months after surgery) did not have a statistically significant difference based on the type of thyroidectomy surgery, thyroid cancer, Hashimoto's disease and multinodular goiter, the duration of surgery, hematoma ($P > 0.05$), but calcium one month after surgery in Graves and Voxani patients who had recurrent nerve damage had a statistically significant relationship ($P < 0.05$).

Conclusion: Identifying and accurately understanding the factors related to the occurrence of hypocalcemia after thyroidectomy is very important in improving surgical results and reducing side effects. It is recommended that physicians carefully identify risk factors and employ appropriate preventive strategies, including monitoring calcium levels and prescribing necessary supplements.

Keywords: Central Hypocalcemia, Thyroidectomy, Graves

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Background and Objective

Thyroidectomy is widely acknowledged as the premier surgical method for managing thyroid disorders.[1] The primary indications for this procedure encompass thyroid malignancies, hyperthyroidism, the manifestation of pressure symptoms, and cosmetic purposes.[2] Nevertheless, thyroidectomy is associated with several complications, including hematoma, recurrent laryngeal nerve injury, hypoparathyroidism, hypocalcemia, and postoperative bleeding.[2,3] The occurrence of hypocalcemia following total thyroidectomy is relatively common and poses significant treatment challenges. The primary cause of hypocalcemia is postoperative hypoparathyroidism, particularly in cases involving total thyroidectomy with simultaneous central neck dissection. This condition arises due to factors such as manipulation or direct injury, devascularization of the parathyroid glands during surgery, obstruction in the venous drainage pathway, or inadvertent resection of the parathyroid glands.[4-6]

Postoperative hypocalcemia can be diagnosed based on laboratory findings (serum calcium < 8 mg/dl) and clinical evidence such as numbness and paresthesia around the mouth and fingers, mental symptoms, tetany, and positive physical examination signs such as Chvostek's sign and Trousseau's sign.[7] The outcomes of postoperative hypocalcemia include prolonged hospitalization and the necessity for calcium supplementation in cases where there is a significant drop in serum calcium levels accompanied by clinical symptoms.[8] Consequently, recent studies have aimed to identify which patients are at risk for developing postoperative hypocalcemia. Among those who develop hypocalcemia, 50% experience transient hypocalcemia, while less than 2% suffer from permanent hypocalcemia. Although surgical skill is paramount in preventing various complications following thyroid surgeries, different studies have highlighted predisposing factors associated with the occurrence of postoperative hypocalcemia. These factors include the severity of preoperative calcium drop, the number of parathyroid glands present during surgery, PTH levels on the first postoperative day, the association of total thyroidectomy with transient hypoparathyroidism, bilateral central neck compartment dissection (Bilateral CND), advanced age, and female gender.[9-11]

Identifying factors related to the occurrence of hypocalcemia following thyroidectomy surgery is of paramount importance, as hypocalcemia is one of the common and serious complications of this type of surgery. It can lead to severe clinical complications, including seizures, muscle spasms, and cardiac disorders. Recognizing risk factors for this complication aids surgeons in taking necessary precautions, improving surgical outcomes, reducing hospitalization time, and enhancing patients' quality of life. Furthermore, a better understanding of these factors can improve treatment protocols and patient preparation for surgery, ultimately raising the standards of care in thyroid surgery. Therefore, this study aimed to determine the factors related to changes in calcium levels following thyroidectomy surgery.

Materials and Methods

This cross-sectional analytical study aimed to identify factors associated with the occurrence of hypocalcemia following thyroidectomy surgery at Shahid Beheshti Hospital in Qom from 2012 to 2019. The sample size was calculated using the formula for determining means, with a type I error probability of 5%, a power of 0.9, and an odds ratio of 1.56 based on the study by Cho et al. The minimum required sample size was 341 participants, all of whom were included in the study.

Table 1 - Review and comparison of calcium levels at different times based on patients' risk factors

Variable		Calcium level		
		Immediately after surgery	One month after surgery	Six months after surgery
Age		9.16 ±0.75	9.26 ±2.62	9.5 ±0.7
Probability value		0.427	0.125	0.497
Gender	Male	9.17 ±0.79	9.33 ±0.74	9.46 ±0.74
	Female	9.13 ±0.75	9.57 ±4.6	9.52 ±0.71
Probability value		0.756	0.711	0.577
thyroidectomy	Total	9.15 ±0.76	9.6 ±4.5	9.52 ±0.7
	Subtotal	9.12 ±0.76	9.3 ±0.7	9.5 ±0.71
Probability value		0.688	0.412	0.811
Thyroid cancer	No	9.13 ±0.76	9.58 ±4.83	9.51 ±0.7
	Yes	9.18 ±0.75	9.37 ±0.72	9.5 ±0.76
Probability value		0.623	0.721	0.855
Hashimoto	No	9.15 ±0.76	9.57 ±4.53	9.52 ±0.72
	Yes	8.95 ±0.75	9.17 ±0.69	9.4 ±0.67
Probability value		0.177	0.644	0.451
Graves	No	9.14 ±0.77	9.32 ±0.73	9.52 ±0.72
	Yes	9.1 ±0.68	10.51 ±10.5	9.74 ±0.68
Probability value		0.887	0.043	0.623
Multinodular goiter	No	9.11 ±0.72	9.7 ±6.1	9.4 ±0.7
	Yes	9.17 ±0.79	9.37 ±0.74	9.58 ±0.72
Probability value		0.514	0.441	0.065

Table 2- Review and comparison of calcium levels at different times based on time and surgical complications in patients

Variable		Calcium level		
		Immediately after surgery	One month after surgery	Six months after surgery
Surgery duration	Under 60 minutes	9.18 ±0.75	9.36 ±0.75	9.53 ±0.74
	Between 60 and 120 minutes	9.11 ±0.76	9.58 ±4.9	9.1 ±0.71
	Above 120 minutes	9.5 ±0.74	9.5 ±0.6	9.6 ±0.63
Probability value		0.165	0.932	0.465
Hematoma	No	9.13 ±0.75	9.56 ±0.52	9.51 ±0.71
	Yes	9.27 ±0.81	9.33 ±0.72	9.47 ±0.74
Probability value		0.355	0.799	0.771
Nerve damage	No	9.14 ±0.76	9.31 ±0.73	9.51 ±0.71
	Yes	9.11±0.7	12.8 ±0.87	9.52 ±0.7
Probability value		0.856	0.001	0.921

Upon obtaining an ethics approval code from the university's research council and presenting an introduction letter from the university's vice chancellor for research to the director of Shahid Beheshti Hospital, the researcher accessed the medical records and laboratory unit. Ethical considerations were meticulously observed while collecting samples from the archives of medical records. The data collected included demographic variables, type and duration of surgery, surgical complications, goiter, Graves' disease, and thyroid cancer. The data were subsequently entered into SPSS software version 22. Means and standard deviations were computed for quantitative variables, while frequencies and percentages were determined for qualitative variables. Statistical analyses, including Chi-square tests, independent t-tests, and one-way ANOVA, were performed, with a significance level set at less than 0.05.

Findings

The mean age of patients in this study was 42.16 ± 11.97 years. Of the participants, 47 (12.7%) were men, and 322 (87.3%) were women. Among the patients, 70 (19%) had thyroid malignancies, 28 (7.6%) had Hashimoto's disease, 68 (18.4%) had Graves' disease, and 183 (49.6%) had multinodular goiter.

The table below compares calcium levels immediately after surgery, one month, and six months post-surgery across the studied variables. The results indicated no significant differences in calcium levels at different times based on age, gender, thyroidectomy, thyroid cancer, or multinodular goiter. The only significant difference was observed in calcium levels one month post-surgery in patients with Graves' disease, who exhibited higher calcium levels compared to those without the disease.

Table 2 reveals that calcium levels at different times did not significantly vary based on the duration of surgery or the presence or absence of hematoma. However, a significant difference in calcium levels one month post-surgery was noted based on recurrent nerve damage, with patients without nerve damage showing lower calcium levels one month post-surgery (Table 2).

Discussion

Hypocalcemia is a common complication following thyroidectomy surgery, marked by decreased blood calcium levels. This condition can substantially impact patients' quality of life and, in some cases, lead to more severe complications. Various factors, including specific clinical conditions such as underlying diseases or surgical complications, can contribute to the occurrence of hypocalcemia post-thyroidectomy. Identifying factors associated with hypocalcemia aids surgeons in mitigating the risks of this complication and implementing preventive measures before and after surgery to maintain appropriate blood calcium levels. The objective of this study was to examine the factors related to the occurrence of hypocalcemia after thyroidectomy surgery. Between 2015 and 2017, Vitalijus Eismontas and colleagues in Lithuania conducted a study involving 400 patients who underwent total thyroidectomy. Predictors of postoperative hypocalcemia included preoperative calcium drop, bilateral central neck dissection, and ligation of the right or left inferior thyroid artery. Additionally, the PTH level on the first postoperative day, a history of thyrotoxicosis less than 10 years prior to surgery, and the number of autotransplanted parathyroid glands during surgery were statistically significant factors associated with postoperative hypocalcemia.[4] In our study, the factors significantly associated with postoperative hypocalcemia were recurrent nerve damage and Graves' disease. Hypocalcemia is the most common complication of this surgery, resulting from manipulation, resection, or devascularization of the parathyroid glands during surgery. According to another study, predictors and risk factors for hypocalcemia include preoperative vitamin D levels, serum calcium, and PTH levels, Graves' disease, total thyroidectomy with central neck compartment dissection, female gender, younger age, malignancy, inadvertent parathyroidectomy, and postoperative PTH level drop.[12] In our study, there was a direct statistical relationship between age and immediate postoperative calcium levels, indicating a correlation between patient age and calcium levels immediately after surgery. While this relationship with calcium levels six months post-surgery was indirect, our study found no significant statistical relationship between gender and calcium levels immediately after surgery, one month, and six months post-surgery. Jeong Nam Cho and colleagues conducted a study at the Department of Surgery of an educational hospital in South Korea, examining patients who underwent total thyroidectomy from 2008 to 2014. Among these patients, 2.28% developed transient hypocalcemia, and 6.2% developed permanent hypocalcemia. Risk factors for transient hypocalcemia included younger age, female gender, longer surgery duration, lymph node dissection, parathyroid gland autotransplantation, and malignancy pathology, while no risk factors for predicting permanent hypocalcemia were found.[5]In our study, the duration of surgery was not related to calcium levels post-surgery. Another study conducted in Iran examined 104 patients with benign multinodular goiter (MNG) who underwent thyroidectomy at Imam Reza Hospital in Mashhad. Patients underwent total and subtotal thyroidectomy, and no significant difference in the occurrence of transient and permanent hypoparathyroidism was observed between the two surgical methods.[3] Similar to this study's results, our study also found no significant statistical difference in the type of surgery's effect on post-surgery calcium levels. Contrarily, a study by Kuan-Chen Chen and colleagues in Taiwan between 1998 and 2010 on patients undergoing thyroid surgery concluded that

the highest risk of hypocalcemia after surgery was associated with bilateral total thyroidectomy (BT), and the lowest risk was associated with unilateral subtotal thyroidectomy. Therefore, the more aggressive the thyroid surgery technique, the higher the risk of postoperative hypoparathyroidism.[13]

Conclusion

The occurrence of hypocalcemia after thyroidectomy surgery is a critical issue in the fields of surgery and endocrinology. Identifying and analyzing various factors contributing to this complication can improve treatment outcomes and reduce postoperative complications. Awareness of risk factors and the implementation of preventive measures, such as close monitoring of blood calcium levels and the use of calcium and vitamin D supplements, are strategies that can reduce the incidence of hypocalcemia in patients undergoing thyroidectomy. Ultimately, paying attention to these factors and implementing appropriate treatment approaches can enhance surgical outcomes and improve patients' quality of life. Future research and studies in this area can further our understanding of this complication and aid in the development of more effective treatment protocols.

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