

Research Article

Role of vitamin D as a risk factor in post-thyroidectomy transient hypocalcemia: a prospective study

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ABSTRACT

Background: With increase in the number of thyroidectomies, the incidence of post-operative hypocalcaemia has seen a rise as well. Deficiency of vitamin D has long been debated as a risk factor for post thyroidectomy hypocalcaemia. The advantage of using vitamin D as a predictor for post-operative hypocalcaemia is (i) easy to estimate (ii) any deficiency can be easily corrected.

Methods: A prospective study with total of sixty one patients who underwent total thyroidectomy irrespective of the pathology. Serum calcium and vitamin D were investigated preoperatively. Serum calcium was repeated in post-operative period. The association between vitamin D and hypocalcaemia was evaluated using Fischer's exact test.

Results: Hypocalcaemia was seen in 14.28% of patients with lower vitamin D levels. When Fischer's exact test was applied, two tailed 'p' value is 0.5195, which is not statistically significant.

Conclusions: Though vitamin D estimation can be an easy method in predicting post thyroidectomy hypocalcaemia, our study does not indicate the same.

Keywords: Vitamin D, Hypocalcaemia, Post thyroidectomy

INTRODUCTION

Total thyroidectomy is one the most common surgeries performed worldwide. Surgeons prefer a total thyroidectomy to subtotal or Dunhill thyroidectomy. With increase in the number of thyroidectomies, the incidence of post-operative hypocalcaemia has seen a rise as well.¹ Risk factors for post-operative hypocalcaemia are older age group, female sex, Grave's disease and inadvertent excision of parathyroid glands. Hormonal risk factors include pre-operative low levels of serum calcium, parathormone and vitamin D levels.^{2,3} Deficiency of vitamin D has long been debated as a risk factor for post thyroidectomy hypocalcemia. The advantage of using vitamin D as a predictor for post-operative hypocalcaemia is (i) easy to estimate (ii) any deficiency can be easily corrected.^{1,4,5} However, the

association between low vitamin D and post-operative hypocalcaemia has not been demonstrated regularly.⁶⁻⁸

METHODS

A prospective study which includes patients treated with total thyroidectomy with or without neck dissections. All the patients underwent estimation of serum calcium, serum albumin and vitamin D levels preoperatively. Serum calcium was repeated at the occurrence of symptoms of hypocalcaemia, at post-operative day 3 and at three months. Patients who had persistent hypocalcaemia at the end of three months were excluded from the study. Other exclusion criteria were abnormal serum albumin, patients taking calcium supplements pre-operatively and patients with renal diseases.

Normal Serum calcium levels are 8.5-10.5 mg/dl. Values less than 8 mg/dl were considered as hypocalcaemia. Normal vitamin D levels are 20-50 ng/dl. Any values less than 20 ng/dl were considered low.

Data was entered using Microsoft Excel and analyzed using SPSS ver.20.0. Fischer's exact test was applied. A 'p' value of less than 0.05 was considered statistically significant.

RESULTS

Total numbers of patients included in the study were sixty one. There were 55 female patients and six male patients. Patients were between 25 to 70 years of age, with mean age of 43.82 years (Table 1). Low levels of vitamin D were observed in 45.9%. Total number of patients who developed hypocalcaemia were twelve (19.6%). Of the twelve patients who developed hypocalcaemia, four patients had low vitamin D levels (33.33%). Among the patients who have low vitamin D levels, four developed hypocalcaemia (14.28%).

Table 1: Patient demographics.

No. of patients	61
Male	6
Female	55
Age	25-70
Mean	43.82
No. of patients with low vitamin D levels	28 (45.9%)
Male	3 (50%)
Female	25 (45.45%)
No. of patients with hypocalcaemia	12 (19.6%)
Male	1 (16.66%)
Female	11 (20%)

Hypovitaminosis D and hypocalcaemia were seen in individuals of all age group. There was no statistically significant difference among various age groups. There was no significant difference between men and women with respect to either hypocalcaemia or lower vitamin D levels either individually or occurrence together.

Hypocalcaemia was seen in 14.28% of patients with lower vitamin D levels. When Fischer's exact test was applied, two tailed 'p' value is 0.5195, which is not statistically significant (Table 2).

Table 2: Association between preoperative vitamin D levels and post thyroidectomy hypocalcaemia.

	Hypocalcaemia	Normal calcium	Total
Low vitamin D	4	24	28
Normal vitamin D	8	25	33
Total	12	49	61

'p' value is 0.5195

DISCUSSION

Post thyroidectomy, hypocalcaemia can be seen in up to 50% of the patients. Most of these are transient in nature, though permanent hypocalcaemia can be seen in 2%.¹

Calcium is the most abundant cation in human body and is regulated by various hormonal regulators. Serum PTH, calcitonin and vitamin D are the major hormones in calcium homeostasis. PTH secreted by parathyroids regulates calcium through three target organs, the bone, the kidney and the gut. PTH stimulates osteoclasts and hence causes resorption of bone. In kidneys, increases absorption of calcium in proximal convoluted tubule. PTH enhances conversion of 1-hydroxylation of 25-hydroxyvitamin D.⁹

Vitamin D is referred to D₂ or D₃ or both together. D₂ is produced commercially whereas D₃ is produced by the skin on exposure to sunlight. 1,25(OH)₂D₃ is a steroid, the major biologically active metabolite of the vitamin D. Hydroxylation occurs in the liver at the C-25 position to form 25-hydroxyvitamin D, the substrate for the more potent metabolite, 1,25(OH)₂D₃. 25-Hydroxyvitamin D is hydroxylated at the C-1 position in the kidney in the proximal nephron to form 1,25(OH)₂D₃. The renal hydroxylation of 25-hydroxyvitamin D is the major control point in vitamin D metabolism. Factors affecting hydroxylation are phosphate concentrations, circulating PTH concentrations, and calcium concentrations. PTH and phosphate depletion act independently to increase 1,25(OH)₂D₃ production, PTH being the more potent stimulus.^{8,9}

1,25(OH)₂D₃ (i) increases bone resorption (ii) enhances the effects of PTH in the nephron to promote renal tubular calcium reabsorption (iii) increases absorption of calcium from the gut. A low level of vitamin D stimulates PTH secretion.

Vitamin D and PTH hormones interact individually and in synergy to maintain calcium homeostasis. A reduced level of PTH is a potent stimulator of hydroxylation of 25-hydroxyvitamin D and low levels of vitamin D stimulates PTH secretion. Calcitonin has very minimal effect on calcium metabolism in humans.

Hypocalcaemia may be asymptomatic or may present with severe neurological manifestations depending on serum calcium levels. Typical manifestations are Chvostek's and Trousseau's signs, muscle spasms and paresthesia.^{4,10} Risk factors for development of post thyroidectomy hypocalcaemia are older age, female sex, Graves' disease, retrosternal goiters, additional neck dissections, inadvertent excision of parathyroids. Pre-operative lower levels of calcium, PTH and vitamin D are other risk factors.^{2,3} Post-operative hypocalcaemia requires prolongation of hospital stay with calcium and vitamin D supplementation. Patient may require intravenous calcium infusion.

Multiple prospective studies have been conducted to evaluate the correlation of lower vitamin D levels and hypocalcaemia. However no definite conclusions are available. A meta-analysis was done by Edafe O et al., which conclude that preoperative PTH, preoperative vitamin D and postoperative changes in calcium are biochemical predictors of post-thyroidectomy hypocalcaemia. The association between hypovitaminosis D and hypocalcaemia has not been demonstrated regularly. Some authors even suggest prophylactic calcium and vitamin D supplementation, results of which are inconsistent and benefit doubtful.^{1,5,11}

In our study, role of vitamin D in causing post thyroidectomy hypocalcaemia was evaluated. It was found that there is no significant association between the two.

In a study conducted by Nhan C et al., deficiency of vitamin D showed a protective effect. Prolonged deficiency may cause stimulant effect on parathyroids (hypertrophy, hyperplasia of the glands) or enhancement of secretion of PTH.¹² Low PTH is a potent stimulant for hydroxylation of vitamin D and hypovitaminosis D stimulates PTH secretion. And these hormones regulate calcium metabolism through multiple mechanisms.

Though vitamin D estimation can be an easy method in predicting post thyroidectomy hypocalcaemia, our study does not recommend the same. Further studies are needed to evaluate the efficacy of both PTH and vitamin D on post-operative hypocalcaemia synergistically.

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REFERENCES

1. Tredici P, Grosso E, Gibelli B, Massaro MA, Arrigoni C, Tradati N. Acta Identification of patients at high risk for hypocalcemia after total thyroidectomy Otorhinolaryngol Ital. 2011;31(3):144-8.
2. Hung-Hin Lang B, Wong KP, Cowling BJ, Fong YK, Kwan-Kit Chan D, Kin-Yee Hung G. Low preoperative vitamin D levels reduce the accuracy of quick parathyroid hormone in predicting post-thyroidectomy hypocalcemia. Ann Surg Oncol. 2013;20(3):739-45.
3. Chia SH, Weisman RA, Tieu D, Kelly C, Dillmann WH, Orloff L. A prospective study of perioperative factors predicting hypocalcemia after thyroid and parathyroid surgery. Arch Otolaryngol Head Neck Surg. 2006;132(1):41-5.
4. Díez M, Vera C, Ratia T, Diego L, Mendoza F, Guillaumot P, et al. Effect of vitamin D deficiency on hypocalcaemia after total thyroidectomy due to benign goiter. Cir Esp. 2013;91(4):250-6.
5. Wolak S, Scheunichen M, Holzer K, Busch M, Trumpf E, Zielke A. (2016). Impact of preoperative Vitamin D3 administration on postoperative hypocalcaemia in patients undergoing total thyroidectomy (HypoCalViD): study protocol for a randomized controlled trial. Trials. 2016;17(1):101.
6. Erbil Y, Bozboru A, Ozbey N. Influence of thyroidectomy on postoperative serum calcium level regarding serum vitamin D status. A prospective study Caspian J Intern Med. 2015;6(2):72-6.
7. El-Shinawi M, El-Anwar A, Nada M, Youssef T, Fakhry E, Raslan S, El-Gohry H. Oral calcium and vitamin D supplementation after total thyroidectomy. Thyroid Res Pract. 2014;11:98-102.
8. Kirkby-Bott J, Markogiannakis H, Skandarajah A, Cowan M, Fleming B, Palazzo F. Preoperative vitamin D deficiency predicts postoperative hypocalcemia after total thyroidectomy. World J Surg. 2011;35(2):324-30.
9. Al-Khatib T, Althubaiti AM, Althubaiti A, Mosli HH, Alwasiah RO, Badawood LM. Severe vitamin D deficiency: a significant predictor of early hypocalcemia after total thyroidectomy. Otolaryngol Head Neck Surg. 2015;152(3):424-31.
10. Edafe O, Antakia R, Laskar N, Uttley L, Balasubramanian SP. Systematic review and meta-analysis of predictors of post-thyroidectomy hypocalcaemia. Br J Surg. 2014;101(4):307-20.
11. Nhan C, Dolev Y, Mijovic T, Rivera JA, Kallai-Sanfaçon MA, Mlynarek AM, Payne RJ. Vitamin D deficiency and the risk of hypocalcemia following total thyroidectomy. J Otolaryngol Head Neck Surg. 2012;41(6):401-6.
12. Mundy GR, Theresa A. Guise hormonal control of calcium homeostasis. Clin Chem. 1999;45(8):1347-52.

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