ORIGINAL ARTICLE

Is post operative hypocalcemia influenced by the extent of thyroid gland surgery? A study of ninety cases

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Abstract:

Objective: Post operative hypocalcemia is a serious complication of thyroid surgery and is believed to be due to low parathormone (PTH) levels as a result of inhibition of parathyroid gland function during or after surgery. Hemithyroidectomy, subtotal or near-total thyroidectomy are associated with potential risk of removal of two, three or even four parathyroid glands, in addition to the risk of circulatory compromise of the parathyroid due to manipulation of its vessels during thyroid surgery. Incidence of post operative hypocalcaemia after hemithyroidectomy and subtotal thyroidectomy was ascertained.

Design: Prospective, non-randomised and comparative study.

Materials and Method: Ninety patients were inducted in the study. Forty five patients had unilateral nodular disease and underwent extended hemithyroidectomy. The second group of 45 patients had bilateral multi-nodular thyroid disease and underwent sub-total or total thyroidectomy. Both groups underwent capsular dissection. Serum calcium levels were performed pre-operatively, one hour post operatively and 24 hourly for three days. Results were evaluated.

Results: There was no reduction in the level of serum calcium after hemithyroidectomy but there was a significant reduction after subtotal thyroidectomy.

Conclusion: Serum calcium level should be performed as a routine after extensive thyroid resection involving more than one lobe. Post operative serum calcium levels have a predictive value in determining the onset of tetany and whether the patient needs prophylactic treatment prior to discharge from hospital. Surgical resections where three of more parathyroid glands are compromised are more prone to suffer from parathyroid insufficiency.

Keywords: Post- operative hypocalcemia, Dubtotal thyroidectomy, Hemithyroidectomy

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Introduction:

Thyroid surgery encompasses variety of procedures. Surgeons are mainly concerned with the effects of surgery on bleeding, recurrent laryngeal nerves and the parathyroid glands[1]. The surgical effects are associated with disastrous consequences, prolonged admission and repeated surgeries[1]. It is therefore imperative to recognize, prevent and preempt any complications. The aim of the present work is to evaluate the risk of hypocalcemia following hemithyroidectomy, near total and total thyroidectomy and to determine whether early post-operative serial serum calcium levels can be used to predict the future serum calcium level outcome and to develop a rule of thumb in identifying patients who are likely or unlikely to develop significant hypocalcaemia and who can be safely discharged within 24 hours of surgery. Low levels of post operative PTH have been used in many studies to predict the development of hypocalcemia after thyroidectomy[2,3,4].

In our study post operative calcium levels were used as predictor to offset the cost of doing regular serum PTH levels.

For a solitary thyroid nodule involving a single

lobe the recommended surgical treatment is lobectomy, defined as the removal of a complete lobe and the isthmus, whereas for a multinodular thyroid disease the American Association of Endocrinologists recommend subtotal thyroidectomy, defined as the removal of one complete lobe and a major portion of the other lobe as well, is the treatment of choice[5].

Parathyroid are two pairs of small glandular structures situated on the back of the thyroid gland, intimately related to its capsule. They secrete PTH which controls serum calcium homeostasis. Usually four small glands are present behind the thyroid gland, two on each side with a delicate blood supply, but three to six glands have been found. These structures are at risk of surgical extirpation, trauma or devascularization during thyroid surgery[6].

The upper parathyroids are found adjacent to the posterior surface of the middle part of the thyroid lobe, often just anterior to the recurrent laryngeal nerve as it enters the larynx.

The lower parathyroid glands are found on the lateral or posterior surface of the lower part of the thyroid gland or within several centimeters of the lower thyroid pole. Because of the uncertainty of the presence of the lower glands, it is logical to conclude that, there may be a minimum of two and a maximum of four glands respectively. Complete removal of one lobe produces a potential risk of damage to or removal of both parathyroid glands on one side. In a near-total thyroidectomy there is a potential risk of removal or damage to at least three parathyroid glands if the glands are present in their normal site. In a cross sectional study it was shown that the risk of hypothyroidism was greater if less than three parathyroids are preserved in surgery[7].

Parathyroid glands appear tanned and have a small vascular pedicle; they bleed freely when biopsy is performed and turn dark when their vascularity is compromised due to trauma. It is not difficult to differentiate the gland from fat or a small lymph node. Frozen section examination during surgery can be helpful in their identification.

Patients and Method:

In this study we studied the incidence of hypocalcemia in two groups of patients who had undergone thyroid surgery. The first group had a hemi-thyroidectomy and the second group had near total or total thyroidectomy. For the purpose of our study, hemithyroidectomy is defined as removal of one lobe and the isthmus and was performed for unilateral nodular disease and a normal contralateral lobe. Near total thyroidectomy is defined as a hemithyroidectomy and a removal of a considerable part of the contralateral lobe. Only a sliver of tissue was left along the recurrent laryngeal nerve to protect the integrity of the nerve. Total thyroidectomy is defined as the total removal of thyroid gland leaving no residual thyroid gland.

Capsular dissection was done in all cases. This is in the avascular plane outside the capsule, but very close to it, minimizing blood loss. The thyroid gland was approached by separating the strap muscles in the midline, digitally retracting the upper pole of the lobe downwards and ligating the superior thyroid artery flush with the thyroid. Surrounding tissues are separated from the capsule by blunt dissection, from above down, till the middle thyroid vein is encountered in the middle of the gland. This vein is smaller in length and is doubly ligated flush with the gland and cut between sutures. At this level keeping close to the thyroid capsule prevents damage to the recurrent laryngeal nerve behind the prevertebral fascia and also facilitates recognition of the parathyroid glands preventing its inadvertent removal. The branches of the inferior thyroid artery are ligated separately very close to the gland.

Drains were not routinely used in any of the patients[9].

Blood sample for serum calcium was collected in the recovery room before and immediately after surgery and then daily for three consecutive days. Further testing was dictated by the serum levels of the previous test.

In our scenario the cost of doing serial serum

PTH levels was considered inhibitory. Instead blood calcium levels were done.

Results:

Per-operative and three consecutive post-operative calcium levels were assessed. All 45 patients of Group 'I' had a persistent serum calcium levels of 8.0 to 8.5 mgs per dl and none of the patients developed significant reduction of their serum calcium levels, defined as a value below 8 mgs per dl.

In Group II, thirty five patients serum calcium showed levels of 7.5 mgs per dl to 8.0 mgs per dl (sub-group a). Nine patients showed levels of between 6.5 to 7.5 mgs per dl (sub-group b) and only one patient of the second group had persistent levels below 5.5 mg per dl (sub-group c).

Patients belonging to subgroup 'a' and 'b' were given oral and dietary calcium supplements during admission and were discharged on the same treatment and follow-up. Repeat serum calcium levels were done at weekly intervals till they showed improvements in their serum levels. One patient in subgroup 'c' developed clinically overt sign of hypocalcemia in the first six hours post operatively. Hypocalcemia was defined as experiencing signs or symptoms of hypocalcemia perioral and digital paresthesias (Chvostek's sign and Trousseau's sign) and/or having a serum calcium level that was lower than 8.2 mg/dL10,[11]. She was given calcium gluconate intravenously along with Calcitriol.

Discussion:

Postoperative hypoparathyroidism can be temporary or permanent. The incidence of permanent hypoparathyroidism has been reported to be as high as 30% (range 11% to 30%) when total thyroidectomy and radical neck dissection are performed, and as low as 0.9% for subtotal thyroidectomy. Transient asymptomatic hypocalcemia is reported in 30% of patients and 6% patients are reported to develop symptomatic hypocalcemia on the first post op day, requiring calcium supplements. Only 0.1 % to 3 % patients develop permanent hypocalcemia[8].

In a long study of 14,934 patients, followed up for five years, temporary hypoparathyroidism was seen in 8.3% and permanent hypoparathyroidism was seen in 1.7% of all thyroid operations[12].

Postoperative hypoparathyroidism is rarely the result of inadvertent removal of all of the parathyroid glands but is more commonly caused by disruption of their delicate blood supply. Devascularization can be minimized during thyroid lobectomy by dissecting close to the thyroid capsule, by carefully ligating the branches of the inferior thyroid artery on the thyroid capsule distal to their supply of the parathyroid glands (rather than ligating the inferior thyroid artery as a single trunk) and by treating the parathyroids with great care[13].

It is a fundamental principle of surgery that a structure must be identified clearly in order not to damage it. However, routine identification of the parathyroid glands and recurrent nerves has not always been accepted. If parathyroids are seen to be non-viable during surgery and to reduce the incidence of hypoparathyroidism, it has been suggested performing parathyroid auto transplantation at the sternocleidomastoid muscle of any parathyroids excised without viable vascularization[14,15,16].

Iqbal J et al noticed that patients undergoing total thyroidectomy developed asymptomatic hypocalcaemia in 18.8%, and transient symptomatic hypocalcemia needing calcium supplements in 5.45% of the patients. None of the patients in their study developed permanent hypoparathyroidism. They stress on adherence to strict capsular dissection during surgery[17].

Postoperative hypoparathyroidism due to low PTH levels results in hypocalcemia and hyperphosphatemia. It is manifested by circumoral numbness, tingling of the fingers and toes, and intense anxiety occurring soon after surgery. Chvostek's sign appears early, and carpopedal spasm can occur. Symptoms develop in most patients when the serum calcium level is less than 7.5 to 8 mg/dL.

Most asymptomatic patients can leave the hospital on the next day of surgery even if their serum calcium level is 7.8 mg/dL or above. Oral calcium pills should be used liberally. Patients with symptomatic hypocalcemia are treated in the hospital with 1 g (10 mL) of 10% calcium gluconate infused intravenously, and then 5g of this calcium solution placed in each 500 mL intravenous bottle to run continuously, starting with about 30 mL/hour. Oral calcium, usually as calcium carbonate (1250 mg to 2500 mg four times per day), should be started.

With this treatment regimen most patients become asymptomatic and their calcium levels become normal. The intravenous therapy is tapered and stopped as soon as possible, and the patient is sent home on oral calcium pills. This condition is referred to as transient hypocalcemia or transient hypoparathyroidism. Management of more persistent severe hypocalcemia requires the addition of a vitamin D preparation to facilitate the absorption of oral calcium. The use of 1-25-dihydroxyvitamin D (Calcitriol), an active metabolite of vitamin D, produces a more rapid action. Calcitriol (0.5 mcg to 1.0 mcg) with oral calcium carbonate therapy is given four times daily for the first several days, then this priming dose of vitamin D Is reduced. Serum calcium levels must be monitored carefully after discharge, and the dosage of the medications is adjusted promptly to prevent hyper or hypocalcemia. When the serum calcium levels are not controllable, then a parathormone assay should be done to exclude permanent hypoparathyroidism.

There was a small study of 38 patients[2] which establishes that low intra-operative PTH levels co-relates well with biochemical ($p<.001$) and clinical hypocalcemia ($P<.01$). The intra-operative PTH level below reference range and a calcium level of 8 mg/dl measured one day post-operatively predicted biochemical hypocalcemia with a similar sensitivity (90% vs. 90%) and specificity (75% vs. 82%). Intra-operative PTH was slightly better than a first day serum calcium concentration of less than 8 mg/dl to predict symptomatic hypocalcemia with a sensitivity of 71% vs. 52% and a specificity of 81% vs. 76% respectively.

Another study of 270 patients[18] establishes that a PTH cut-off level of 15 ng/dl has a good predictive value for low hypocalcemia in 80% patients.

Conclusions:

In the present day medicine reducing hospital stay cuts treatment costs and prevents nosocomial infection.

We concluded that it is possible to:

- Reduce the hospital stay of patients after thyroid surgeries if three post operative problems, which prevent early patient discharge, are adequately addressed, i.e., post-operative bleeding, recurrent laryngeal nerve paralysis and hypoparathyroidism.
- Discharge the patients within 24 hours of hemithyroidectomy without the fear of late development of hypocalcemia. Those patients who undergo subtotal, near-total or total thyroidectomies should have post operative serum calcium levels done. Patients with low serum levels of calcium should have mandatory calcium supplements till their levels are regained[19].
- Keep the morbidity low by keeping close to the capsular avascular plane.
- Perform low cost serum calcium levels to predict parathyroid insufficiency rather than use the higher costing serum PTH levels.
- Develop a patient discharge criterion, including post operative serum calcium levels, to be able to discharge the patient on the second post-operative day.
- Our study showed that although it is possible to use serum calcium levels to predict parathormone insufficiency, it is necessary to do a larger co-relational study to assess positive co-relations between serum calcium and serum PTH levels so that appropriate clinical recommendations can be made.

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